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New Power Equipment of Federal Building

DISCONTINUANCE OF CENTRAL STATION SERVICE NECESSITATED ADDITION OF GENERATING UNITS; SOME RESULTS OF ONE MONTH'S OPERATION

ABOUT A YEAR ago announcement was made that Secretary of Treasury McAdoo was making plans to discontinue the use of central station current in the Federal Bldg. in Chicago. This building has, until the first of March this year, done all its lighting and operated all its motors with current purchased from the central station, so when the announcement came that electric generating units would be installed as part of the power equipment, considerable interest was aroused.

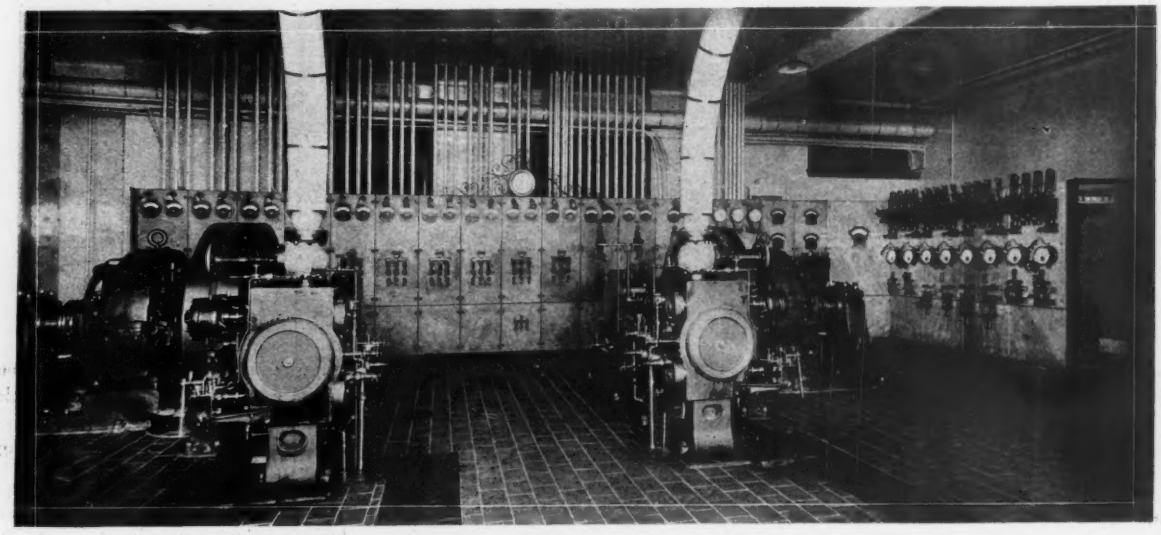


FIG. 1. ONE-HUNDRED KW. UNITS IN FEDERAL BUILDING PLANT WITH SWITCHBOARD IN BACKGROUND

Government engineers have been confident that considerable saving would result from the change and the results of one month's operation as shown later sustains them.

The Federal Bldg. covers the entire space between Jackson Blvd. and Adams St. between Dearborn and Clark Sts., and a great share of the basement is devoted to power plant machinery; a great deal of this is driven by electricity, but the larger part is steam driven, which together with the heating system made it advisable to install 5 boilers in the original plant with a total capacity of 1750 hp.

To operate the new generating units, no new boilers were added nor, strange as it may seem, do the firemen notice the extra load on the boilers due to the new equipment. This is accounted for by the fact that the exhaust is used for heating whereas, formerly, live steam at reduced pressure was necessarily used a good share of the time to help out.

SERVICES RENDERED

TO GET an idea of the problems which present themselves to the engineering force of this building, it is desirable first to learn what services are rendered. The

occupants of this building are wonderfully well provided with mechanical and electrical conveniences which make work comfortable, easy and rapid. Steam driven hydraulic elevators, both passenger and freight, eliminate the necessity of stair climbing. Electric lights are provided at nearly every desk, besides those for general lighting. Fresh, purified air makes life in the building a comfort. Hot and cold water, heat and refrigeration all add to the comforts in Uncle Sam's building.

One of the principal conveniences and what has done more, perhaps, than any other equipment of the building for rapidity in handling mail and other papers, is the pneumatic tube system. This not only carries papers from one department of the building to another, doing away largely with errand boys, but an extensive system of tubes, about 11 mi. in all, extends to railway stations and other points about the city where great quantities of mail are collected.

Percentage of load....per cent..	25	50	75	100	125
Load factor.....per cent..	10	20	50	15	5

The algebraic sum of the savings at various loads when operating under conditions given above would represent the gross savings per year effected by the units with the lower steam consumption over the units with the higher guaranties.

The engines are of the single-cylinder, automatic, horizontal, side crank type, made by the Harrisburg Foundry & Machine Works. They are designed to operate noncondensing on dry saturated steam at 150 lb. gage pressure at the throttle. The speed of the 100-kw. generator engines is 250 r.p.m., dimensions 14 by 17 in., and the 200-kw. generator engines run at 200 r.p.m., dimensions, 17 by 20 in.

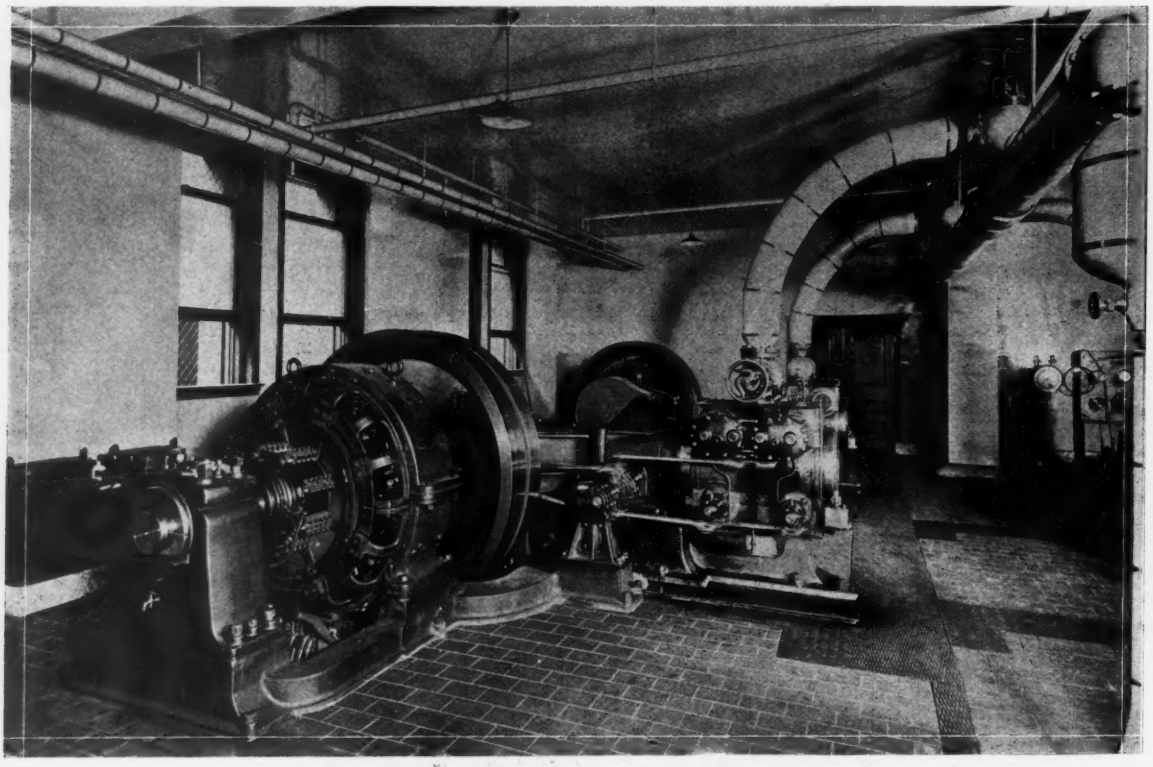


FIG. 2. LARGE GENERATING UNITS AND STEAM PIPING

Engine Room

TAKING UP more in detail the power plant equipment, the part that interests us most at this time is the engine room machinery. Generating units were built upon specifications drawn up by the government engineers. These cover the installation complete of 2 200-kw. generators, 2 100-kw. generators, and engines, and new sections of switchboard.

Cost to generate steam was considered 16 cents per thousand pounds. Each unit was assumed to operate 8 hr. a day, 365 days per year, and at the following load factor:

The engines are designed so as to operate most economically when generators are delivering ¾ load at the rated voltage and speed, and are capable of operating the generators for 2 hr. when delivering 25 per cent overload at rated voltage.

Each engine is provided with a heavy and substantial cast-iron frame designed for strength, rigidity, and compactness, and is provided with suitable covers to prevent throwing of oil and allowing dust to come in contact with the moving parts.

Bearings are long, well proportioned, and dust proof. The main bearing is of the removable-shell type, and the outboard bearing is of the oil ring type. Bearings are lined with genuine babbit metal carefully peened in place and accurately bored to gage. The outboard bear-

ings are provided with large-size oil wells, gage glasses, and pet cocks for drawing the oil. Bearings are provided with means for adjustment.

Each engine is provided with an automatic self-lubricating continuous circulating system which supplies pure, clean oil continuously to all bearings, etc., the operation of the system is positive and free from throwing or spilling the oil.

Each cylinder is made of best grade of close-grained cast iron bored true and smooth, and of sufficient thickness to allow for reboring. The cylinder is well lagged with heat insulating material and covered.

Each engine is fitted with 4 valves of the semi-rotary type, designed to be slightly unbalanced and secure positive steam-tight seating over the admission and exhaust ports. Steam valves are of the multiported type, giving ample port openings for all points of cut-off. Exhaust valves are designed to give ample port area and insure tightness.

The valve mechanism on each engine is designed to give quick and positive motion to the valves in opening and closing. Lubrication of pins and bearings is accomplished while in motion by compression grease cups placed at accessible points or to operate in oil wells.

Each engine is equipped with 2 eccentrics, strong and light to reduce the strain upon the governor springs, ample means of lubrication is provided.

Each engine is equipped with an inertia governor. The governor pins are made of steel, hardened and ground true. The lever-arm bearing is made with hardened steel bushings and rollers.

Generators

The new generators were furnished by the Westinghouse Electric & Mfg. Co., and are direct-connected engine-driven compound-wound interpole type for 3-wire 115-230-volt direct current, each mounted on subbase connected to its engine subbase.

The 100-kw. generators have full-load rating of 400 amp., 250 r.p.m. The 200-kw. generators have full-load rating of 800 amp., 200 r.p.m.

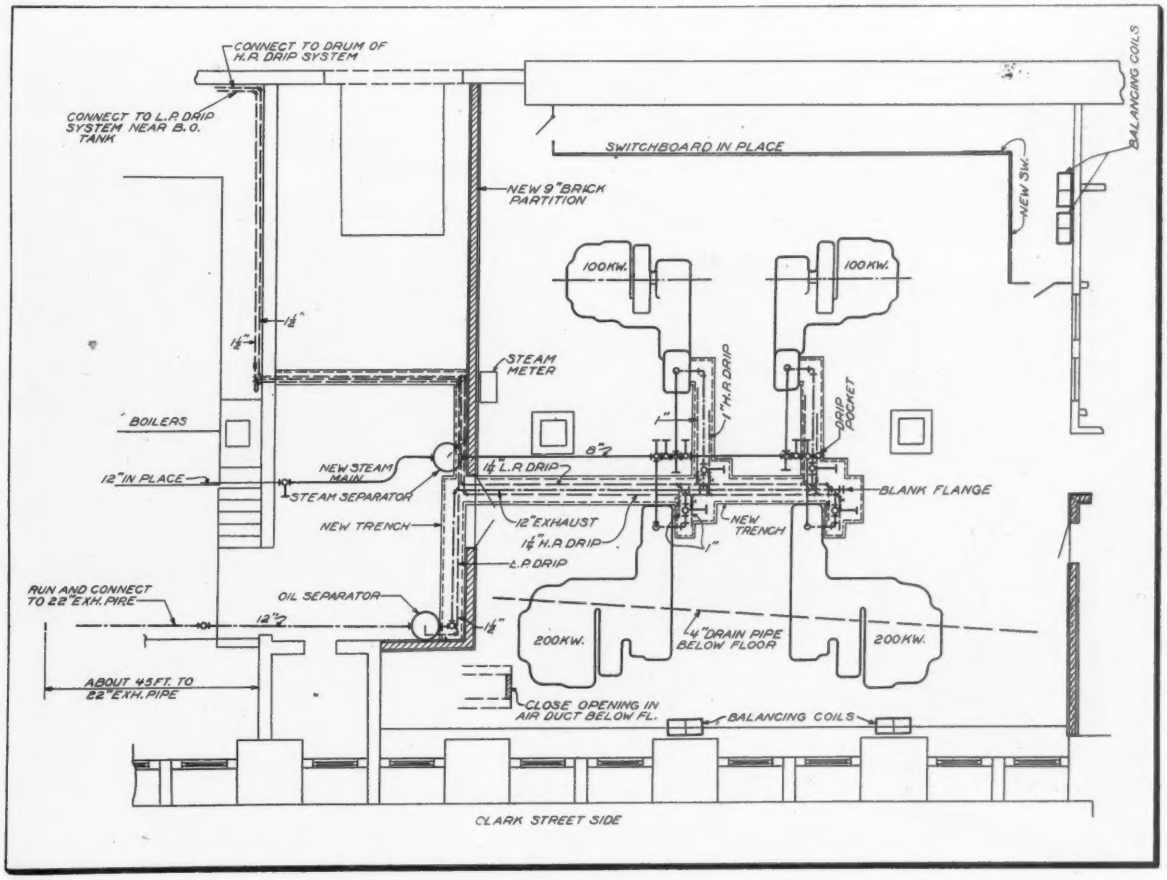


FIG. 3. PLAN OF ENGINE ROOM AND PIPING

Armatures and commutators are built upon ventilated sleeves or spiders, pressed on and keyed to shafts. The field or magnet frames are provided with screws and liners for adjustment in position. The machines run in parallel.

Frames of generators are made of high-grade metal of high permeability. The poles are made of laminated steel, bolted to the frames. The interpoles are of steel, bolted to the frames.

Main field coils are form wound, provided with ventilating ducts, and so secured that they may be readily removed without unwinding. The series field is divided so that one-half will be connected in the positive line,

one-half will be connected in the negative line and be proportioned to give automatically the desired voltages.

The armatures have slotted cores, the windings being thoroughly insulated, provided with ventilating ducts for cooling the windings.

The voltage regulation is 230 volts no load to 230 volts full load at the switchboard, based on a variation of speed in the engine of not more than 2 per cent from no load to full load.

Balancing coils of the generators are of oil cooled type, and are capable of carrying 25 per cent of the full rated current of generator in outside wires, in the neutral wire, and the variation in voltage between the neutral and the outside wires will not exceed 3 per cent above or below normal.

current. Complete new sections of switchboard were provided for controlling and measuring all current generated by the 4 3-wire compound generators for light and power.

The new sections of switchboard consist of 4 panels of marble, same quality, color, and finish as the old board.

Generator switches are double-pole, single-break, knife pattern. Switch handles are rubber composition and cross-bars are of polished hardwood or fiber of non-absorbent quality.

All bus bars are rectangular in cross section and are built up of copper strips, with air space between each bar equal to thickness of bar. Bus bars from generator panels are connected to bus bars on old board on the

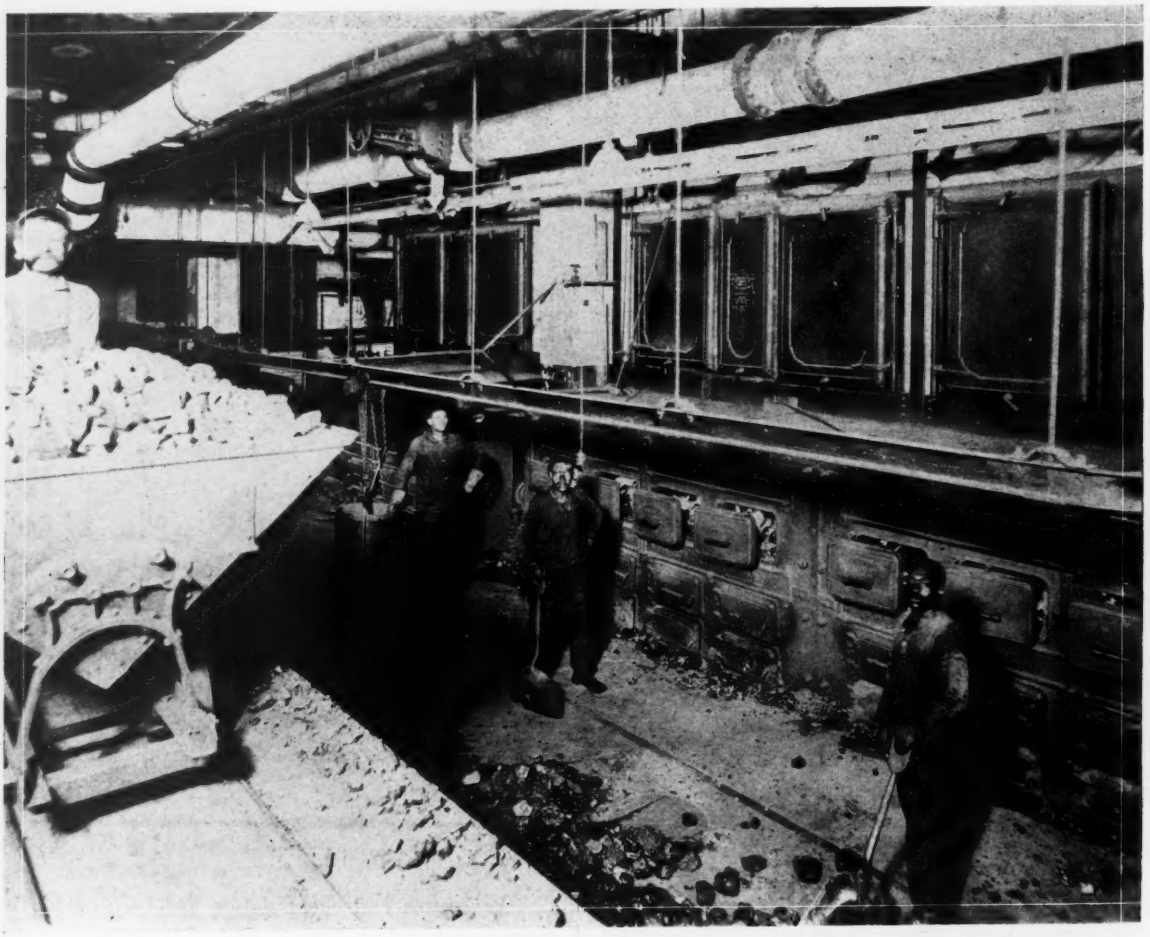


FIG. 4. VIEW IN THE BOILER ROOM SHOWING COAL AND ASH CONVEYING EQUIPMENT

The temperature rise of the armatures, commutators, and field coils does not exceed 35 deg. C. above the surrounding air, corrected to 25 deg. C. on continuous full load.

SWITCHBOARD

THIS WAS furnished by the Westinghouse Electric and Mfg. Co., and installed adjacent to the old switchboard, which was used to distribute the central station

central station service side of the ammeter shunts.

All circuit breakers are of the laminated contact type, the main movable contact members are laminated throughout. All laminated contacts have a current density not exceeding 250 amp. per square inch of contact surface, and all other current-carrying parts have a current density not exceeding 1000 amp. per square inch.

Circuit breakers are equipped with time-limit devices, which are so constructed that the time-limiting

action is attained without the movement of any parts whatever, except at the instant of tripping the circuit breaker.

Circuit breakers are also equipped with nonclosable on overload feature, so equipped that should an attempt be made to close the circuit breaker against overload or short circuit, it will not remain in the closed position even though the operating handle be held in the closed position. The nonclosable on overload construction is such that the movable switch members of each multipolar instrument are united and will open or close at all times as a unit.

Final break is made upon carbon blocks, which maintain rubbing contact throughout an extended surface until the circuit of the main and secondary metallic contacts is broken, and is of such a form that friction between the carbons will not tend to overcome the force which opens the circuit breakers. All contacts, main, secondary and tertiary, are of such a nature as to assist the opening movement of the circuit breaker.

Engine Test Results

Following is a report of tests made upon 2 of the engines at the factory by government engineers, giving the pounds steam per kw.-hr. guaranteed and obtained at 150 lb. pressure:

100-Kw. Unit

Load.	25%	50%	75%	100%	125%
Guarantee per Kw.-Hr.	59.6	37.3	33.5	33.2	34.2
Amount by test per Kw.-Hr.	45.98	34.51	32.03	32.47	33.7
Dry steam per I. Hp.	25.12	21.02	19.88	20.35	21.03

200-Kw. Unit

Load.	25%	50%	75%	100%
Guarantee per Kw.-Hr.	58.3	37.1	33.3	32.8
Amount by test per Kw.-Hr.	41.6	31.67	30.43	32.04
Dry steam per I. Hp.	25.1	19.9	19.4	20.6

The steam piping to these units is the most simple imaginable, the main header running through the engine room as shown in the plan, Fig. 3, being supported every 8 to 10 ft. by heavy adjustable hangers. A large receiver separator is placed in the pipe line just before it enters the engine room and is drained by a Crane-tilt trap. Exhaust is led back to the feed-water heater in the boiler room through an oil separator or to the heating system as desired. All piping is thoroughly insulated with pipe covering.

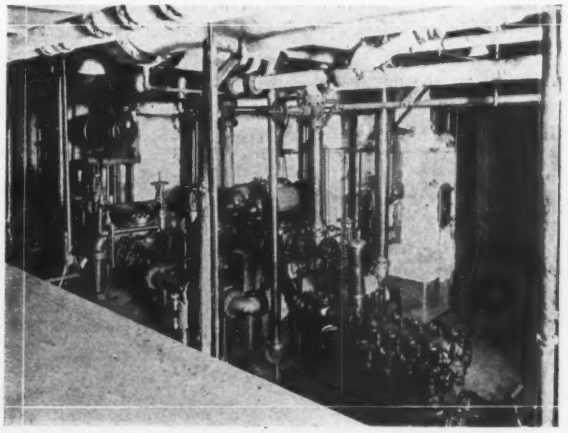


FIG. 5. BOILER FEED PUMPS AND FEED-WATER HEATER IN FEDERAL PLANT

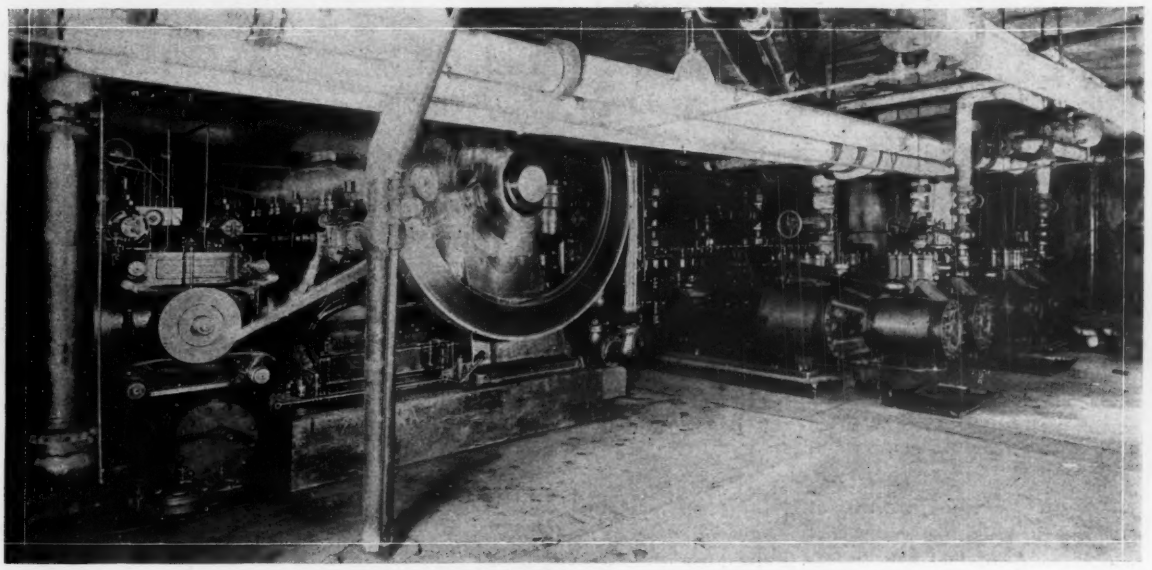


FIG. 6. ELEVATOR PUMP LOCATED UNDER MAIN CORRIDOR OF BUILDING

Among the new equipment is a G. E. steam flow meter which indicates, records graphically and integrates the amount of steam being used by the generating units.

Boiler Room

As previously stated, no changes have been made in the steam generating equipment to accommodate the new

electric units and, while not of the latest designs, under the management of Chief Engineer Peterson the equipment is exceedingly economical.

Coal is delivered to bins under the Clark St. sidewalk and carried to the boiler room in industrial dumping cars, which run on rails laid on the mezzanine floor, which is at the level of the basement floor. Each load is weighed as it passes to the firing floor and a complete record of coal consumption is thus obtained.

Firing is done by hand and ashes are carried away in buckets swung by a chain hoist from an overhead rail and dumped into the hopper of an ash elevator at the rear of the battery of boilers, whence they are loaded

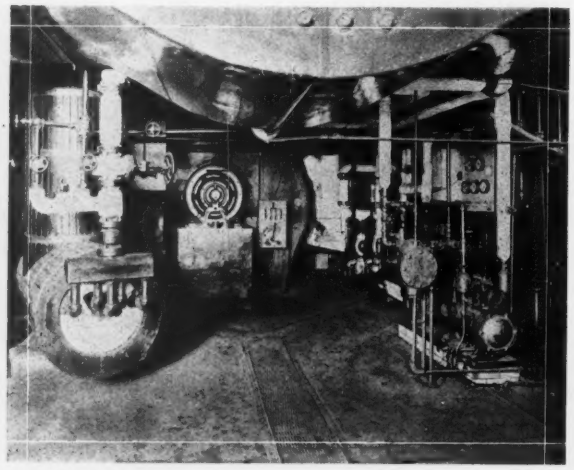


FIG. 7. REFRIGERATING MACHINERY AND AUXILIARY PUMPS; A VENTILATING FAN IN THE REAR

into wagons in the driveway, which runs the length of the building at about the level of the basement floor.

The flue gases are conducted by a common breeching to a Green fuel economizer of 5000 hp. capacity, which necessitates the use of an induced draft fan during warm weather in order to give the boilers proper draft.

The draft fan is direct connected to a cross compound engine, 10 by 14 by 8, which is automatically controlled by a Kieley regulator.

Feed water for the boiler is largely returns from the heating system, which are delivered to a receiver tank in the boiler room, above the heater shown in Fig. 5, it has a capacity of 900 gal. and feeds by gravity to the Webster open heater.

Makeup water is taken from the city mains, first passing through a coil in the blowoff basin, then the economizer tubes and delivered to the receiver tank under control of a float valve. The temperature of the water as it leaves the heater is 208 deg.

Two feed pumps are provided, one a Worthington duplex 12 by 7 by 10 in., the other an o.p.p. 12 by 10 by 6 in. These feed to the boilers through a header direct into the boiler drums. An injector is also provided to help out in case of need.

There are 5 Aultman & Taylor, 2-drum, water-tube boilers, each rated at 350 hp. developing steam at 160 lb. pressure. These are equipped with Hawley down-draft furnaces, with the standard setting, and Vulcan soot cleaners. Draft is regulated by a Spencer damper control system.

Among other important apparatus in the boiler room are a recording steam flow meter, a vacuum pump for the heating system, a sewage pump, traps for drip lines, etc., some of which are shown in Fig. 5.

Elevators and Special Machinery

There are 2 small electric, and 7 passenger and 8 freight hydraulic elevators; water for the latter is supplied by 3 pumps located under the main corridor. The main pump is of the crank and flywheel type with Corliss valve gear with dimensions 16 by 20 by 20 by 5½ by 24 in. The other two are direct acting, each 16 by 25 by 7⅜ by 18 in., all made by the Laidlaw-Dunn-Gordon Co.

On the opposite side of this room is a complete absorption system of refrigeration of 20 tons capacity, built by the Carbondale Machine Co. This is used for cooling water for the drinking fountains, and the several pieces of apparatus are shown in Fig. 7.

House water is pumped by 2 motor driven Goulds triplex pumps, which work under a head of 60 lb. and have cylinder dimensions of 6¼ by 8 in.

Two 2-stage air compressors, driven by direct connected motors, were installed originally to furnish compressed air for pumping an air lift well, but as the well water proved unfit for use, these are now used to supply air for blowing purposes at 120 lb. pressure. One of these is shown in Fig. 8.

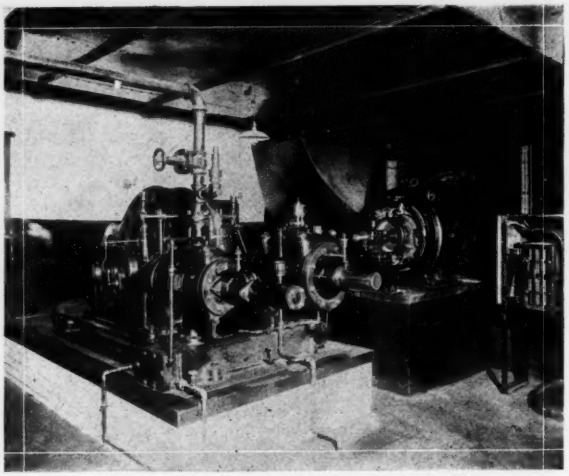


FIG. 8. TWO-STAGE AIR COMPRESSOR AND A MOTOR DRIVEN VENTILATING FAN

One of the most interesting features of this plant is the pneumatic tube system, air for which is furnished by 4 steam-driven compressors at 4 to 9 lb. pressure. They are of the cross-compound tandem type, two of them are shown in Fig. 9.

Dimensions of these compressors are as follows: One has steam cylinders of 10 and 18 in. in diameter, air cylinders 26 in. and stroke 26 in.; two have cylinders 10 and 18 by 26 by 20; the fourth has dimensions 11 and 18 by 24 by 24; all were built by the Rand Drill Co.

Ventilation is secured by the use of 18 motor driven fans, 10 of which are blast and 8 exhaust, besides 4 blast and 4 exhaust fans for the court rooms. These furnish a good share of the motor load upon the generating units. In this connection it may be mentioned that a complete system is installed for washing all air which is delivered to the various parts of the building.

Heating is done by exhaust steam from the various engines and pumps, the Webster vacuum system being employed.

service $5995.59. For March, 1914, the total operating cost was $4519.91, which includes the electric service, amounting to 135,000 kw.-hr. Taking into account the interest, depreciation and overhead charges, the net saving over the cost of service for the same month last year is $1111.67. The cost of the electric service alone for the month was $772.

The change in service speaks well for the business management of the department, and the results obtained show an efficient operating force.

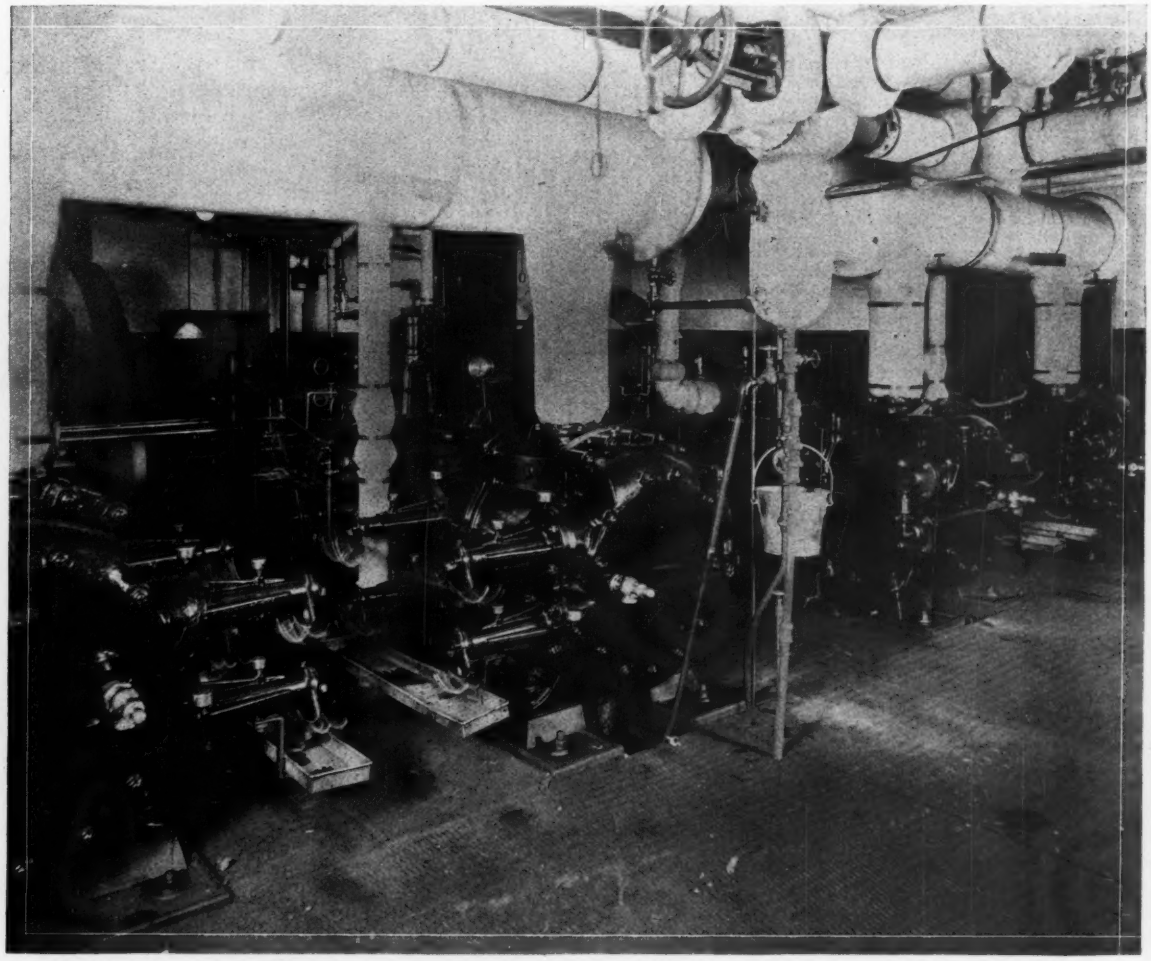


FIG. 9. AIR COMPRESSORS USED FOR THE PNEUMATIC TUBE SYSTEM

There is, of course, a vast amount of other smaller power using machinery, but the above gives an idea of the class and amount of service rendered.

Before contracts were let for the new machinery, it was estimated that a saving of about $11,500 a year would be made to the department by the change, considering the cost of central station service at an average of 1.9 cent per kw.-hr., which is the average price formerly paid.

During the month of March, 1913, total operating expense of the plant was $3927.99, cost of central station current was $2067.60, making the entire cost of the

THE THOUSANDS OF GREAT TREES which are being brought from every country in the world to be transplanted at the Panama-Pacific International Exposition, are scientifically treated by experts to prevent their dying. The side roots are first cut and side-boards placed down the cuts. Six months later, when the tree has become accustomed to receiving nourishment only from its bottom roots, these are cut and a bottom board attached to the side ones, making a great box. The tree is then hoisted by derrick and shipped by land or sea to San Francisco, where it is replanted in special soil brought from the Sacramento River, 70 miles away.

Carrying the School and Experimentation to the Power Plant

ESTABLISHING BY EXPERIMENTS THE BEST POSSIBLE RUNNING CONDITIONS FOR AN INSTALLATION; PROVING TO THE RESPONSIBLE OPERATIVES OF A SYSTEM THAT THESE CONDITIONS ARE RIGHT, AND SHOWING THEM HOW TO OBTAIN LIKE RESULTS IN THEIR OWN PLANTS

IN the Peoria Station of the McKinley System, conditions of operation have changed during the last 8 yr. in such manner as to require the hardest kind of service from the boiler plant. The station and its equipment throughout were well planned and the apparatus well chosen, but power has been called for in such quantities that at one time, during a period of 8 months, all the boilers in the plant were running 24 hr. a day without one of them being shut down once for any reason. It is evident that, starting with the best of economy, such service conditions as this must result in gradual slow decline due to wear and tear, and there is likelihood of some unfortunate operating practices creeping in because of the drive to keep all the machinery working at any cost. Recent records showed that the station was using some 43 lb. of steam per kilowatt-hour, based on the overall load of the station, which included the auxiliary requirements for steam, most of which are steam driven. Boiler room tests showed that the evaporation was 7 lb. of water per pound of coal, so that there seemed to be some discrepancy in the figures as compared with the records from other plants of the system.

As mentioned in the April 1 issue, Joseph Harrington, of Harrington & Peebles, Chicago, Ill., was engaged by the management of the McKinley System to undertake a series of tests to determine what might be the best operating conditions for the plants on the system, and then to show those in charge of such plants, how to attain and retain the best operating conditions for the installations under their charge.

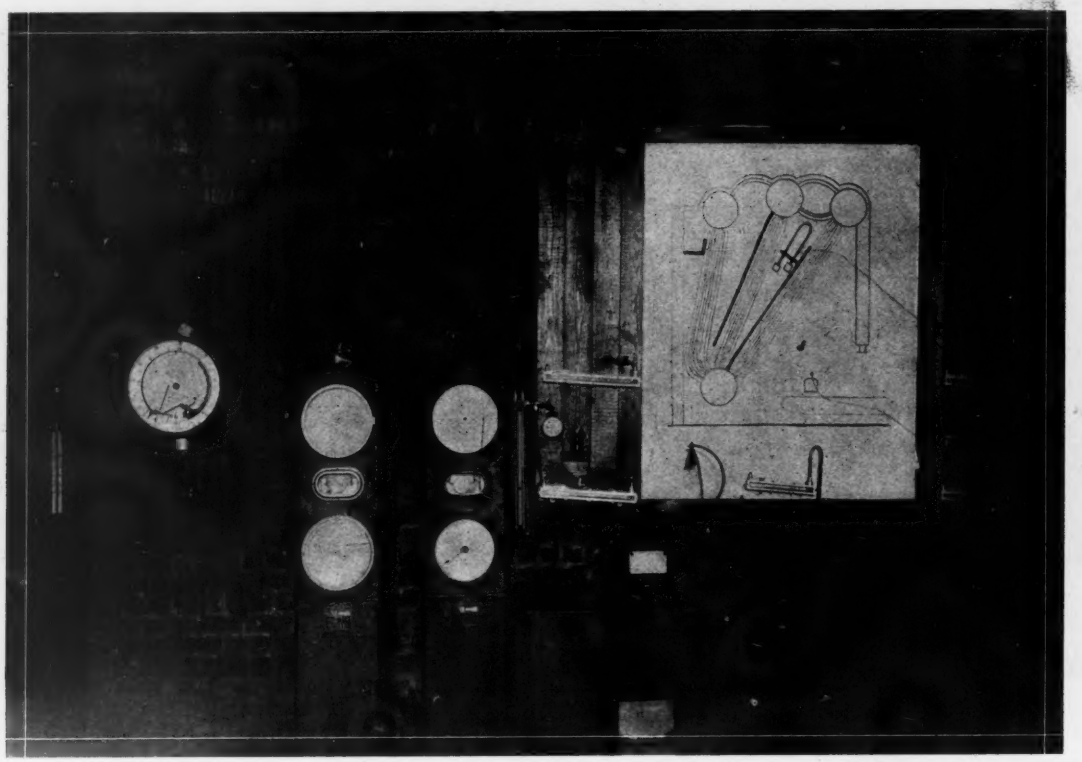


FIG. 1. METERS AND GAGES AT THE END OF THE BOILER ROOM. FROM THE LEFT; BAROMETER, GENERAL ELECTRIC INDICATING, RECORDING AND INTEGRATING FLOW METER, VENTURI ON TEST BOILER, VENTURI ON PLANT, MERCURY GAGE TO CHECK VENTURI METER, DRAFT GAGES ON THIRD PASS, CHART OF BOILER SETTING, DRAFT GAGE IN SECOND PASS, DRAFT GAGES IN SUPERHEATER AND FURNACE, BLONCK EFFICIENCY METER

Obviously, the first work was to discover the causes of loss in the plants, and Peoria Station was taken first because of the conditions already mentioned, which made it desirable to better the performance there, and also because it was centrally located and was typical of the other plants. After the causes of the losses have been discovered, the next step is to try methods of boiler

setting and operation which will eliminate these losses, and will keep the performance up to the highest possible. The first work that Mr. Harrington did was to make tests on the plant as it stood, to determine its economy and the conditions under which it was operating. These tests showed that an operating range of from 400 to 520 hp. could be secured on a nominal 400-hp. boiler with natural draft, and that it was possible to give the chain grates a travel of only 2½ in. a min., or the coal did not ignite as it entered the furnace. In view of the fact that it ought to be possible with these Green chain grates to get a travel of 8 in., with the coal igniting readily, it was evident that there was something radically wrong in the combustion conditions in the boiler.

nected. Ellison draft gages were used, the first being connected into the side wall, under the combustion arch, and near the rear end of the grate; the second was connected in the first pass just in front of the superheater; the third, in the same pass, just behind the superheater; the fourth, at the beginning of the third pass, a little above the mud drum; the fifth, in the passage where the gases leave for the stack. In addition to these, a Blonck efficiency meter was used, connected in the regular manner, as described in the Jan. 1 issue, and this was found substantially correct for the damper draft, but registered slightly high for the furnace draft.

In connection with this instrument, it might be said that Mr. Harrington has found that the difference be-

FIG. 2. RECORDING INSTRUMENTS AT BACK OF BOILER. FLUE GAS TEMPERATURE, FEED-WATER TEMPERATURE, BOILER PRESSURE, SUPERHEATER DELIVERY PRESSURE, SUPERHEATER THERMOMETER, DRAFT AT INTAKE TO CO_2 RECORDER, HAND ORSAT APPARATUS, HAYS CO_2 RECORDER, UEHLING CO_2 RECORDER

As a large number of tests had to be made, and it was desirable to do this with as little labor and as small testing force as possible, Mr. Harrington arranged his testing instruments, as shown in the illustrations, Fig. 1 being a photograph of the end wall of the boiler room, showing the arrangement of draft gages, the steam flow meter, and the Venturi feed-water meter, and Fig. 2 an attempt to show the equipment of recording thermometers and gages which were installed, as was also the gas analysis apparatus and CO_2 recorder, at the rear of the boiler under test. In Fig. 1 is shown also a diagram of the boiler setting as it was found when the work at the plant was undertaken, and with line drawn indicating the points to which the draft gages are con-

tween the damper draft and the firebox draft should increase slightly with the load, in order to give the furnace best furnace conditions, because the resistance through the boiler passages increases with the load, on account of the greater amount of coal burned and the greater volume of gases drawn through the boiler passages. For a range of combustion from 10 lb. per sq. ft. of grate up to 30 lb., however, the difference between damper draft and furnace draft is nearly constant, and the Blonck meter will give practically correct guidance in handling the fire.

For keeping track of the composition of the gases, a Hays hand Orsat apparatus was used, and this was used also to check the Hays and Uehling CO_2 recorders

which were connected for continuous record. It was found that the indications agreed within 1 per cent.

Tests for gas composition at different points in the boiler setting showed that at the top of the first pass, a value of 14.2 was found for the CO_2, which decreased to 6 per cent at the damper, due to inleakage of air through the boiler setting. A measurement of temperature drop of gases as they passed through the boiler,

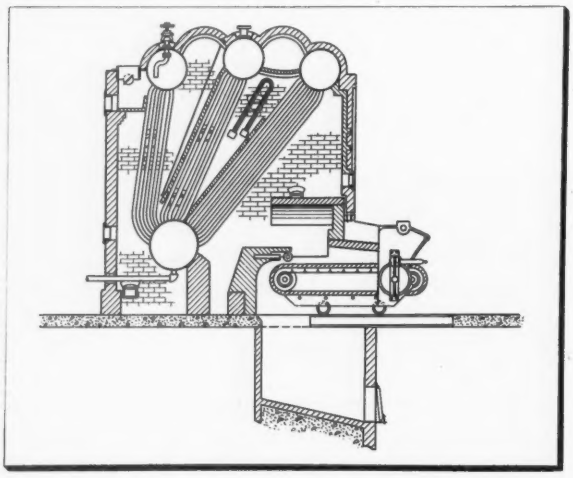


FIG. 3. ORIGINAL ARRANGEMENT OF BOILER SETTING, ARCHES AND BAFFLES

showed that 78 per cent of the work in the boiler was done by the first pass, 9 per cent by the superheater, 5 per cent by the second pass, and 10 per cent by the last pass. This showed a considerable leakage of air through the baffles, as the superheater and the second pass were not doing anything like their share of the work.

From the limited range of horsepower and the impossibility of burning a large amount of coal per square foot of grate, it was quite evident also that something was wrong with the setting, either in design, or condition or both. Instruments were installed to give continuous records of flue gas temperature, feed-water temperature, boiler pressure, pressure at the delivery nozzle of the boiler after the drop in pressure through the superheater, superheater temperature, draft at the intake to the CO_2 recorder, steam flow from the boiler under test, feed water to the boiler, and the CO_2 recorder. To check these readings, the superheat was indicated by a mercury thermometer, the CO_2 values were checked by a hand Orsat instrument, and a mercury pressure tube was used to check the reading of the recording and indicating dials of the Venturi meter on the feed water. To get the weight of coal burned, an Avery automatic coal weigher was installed, set so that it would feed 100 lb. whenever the pan tripped, and the hopper which supplies coal to the stoker was brought up in pyramid shape at the top, so that a feeding of 100 lb. by the stoker produced a drop of 6 in. in the level of the coal under the weigher. Water level was kept constant by a Williams feed-water regulator, mercury thermometers were used to test the feed-water temperature, and the flue gas temperature was checked by a reading from a Bristol electric pyrometer. This equipment of instruments gave continuous records of every part of the boiler data, except the quality of coal, and the weight of ash coming from the grate, and its condition. The coal and ash samples, and the weight of the ash were, therefore, taken by direct observation, all these values being obtained under the eye of Mr. Harrington. The equipment furnished a continuous condition of boiler testing with all readings taken by one man, and as a flying start was taken with the boiler in operation, and the stoker feed was steady throughout the test, there was no correction to be made for level of the fire or any other disturbing factor at the beginning and end of the test.

The equipment of the plant consists of 8 400-hp. Stirling boilers of type L-19, and having Foster superheaters between the first and second passes. The grates are Green traveling link chain grates, 9 ft. wide and 9 ft. deep, giving 81 sq. ft. of grate surface. The setting as found was as shown in Fig. 3, and after the first series of tests was made, it was changed to approximately the arrangement shown in Fig. 4. The inclined ignition arch was made 5 ft. long, with a pitch of 3 in. to the foot, a bridge of firebrick placed above the headers to the superheater, and new baffles put in, making sure that they were tight at all points. Also, the opening above the last baffle at the end of the third pass was enlarged to 24 in. To casual observation, the outer wall of the setting seemed in good condition, but a careful test showed that there were leaks at numerous points, and these were gone over and carefully stopped up with fire clay. It was found, on inspection, that the super-

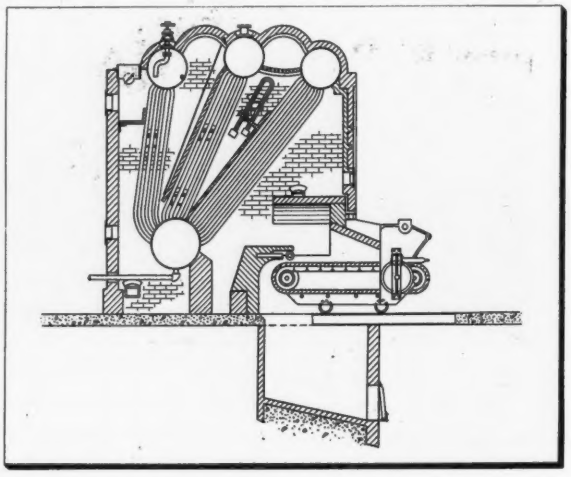


FIG. 4. NEW ARRANGEMENT OF IGNITION ARCH AND BAFFLES

heater projections readily filled up with soot and ashes, and that unless care was taken, this did not get blown off when blowing down the boiler. A test showed that by a simple blowing down on these superheaters, a rise of some 30 deg. in superheat could be secured, and a rise of the overall efficiency from 59 per cent up to 65 per cent.

At the time of visiting Mr. Harrington and talking to him about his work, the tests on the rebuilt setting were just starting, so that no results from this were available. When these tests are completed, further data will be secured.

As the plant is now operated, one man attends to the entire 8 400-hp. boilers, with another man to take away the ashes, but because of the overloading of the plant, it has been a case of "keep it going somehow," without possibility of attempting to conform to best conditions of operation. Feed-water regulators are installed on the boilers, but for some reason these are not operating as they should, probably because of the lack of opportunity to give them proper attention. Furthermore, no means is provided of regulating the load on each boiler, or of telling what draft should be used to give the best result.

Plans that are under consideration for best operation of the system, will include an automatic weigher on each boiler, to keep track of the coal that it uses, a Venturi meter on the feed line to the boiler room, a flow meter on each boiler to indicate the load that it is carrying at any time, and a draft gage to show what draft is being furnished. Testing out will then be carried on to establish the best conditions of draft for each load, so that the draft on a boiler may be regulated according to the steam that it is furnishing.

Study of the turbine room losses will also be made, and the conditions for most economical operation determined. After the Peoria plant is put in shape, it is intended to apply the same method to other plants in the system, and to install suitable methods for securing the cooperation of the engine and boiler-room forces in order to get the best possible results from the plant.

Installation of Economizers*

POINTS TO BE CONSIDERED DURING ERECTION. BY WARREN H. MILLER

THE erection of the economizer is usually done by the makers and should include adjustment of the scrapers and a trial run of the scraper gear. The scrapers are of cast iron and usually include 4 to 6 pipes each. They have a short iron handle to hold them at right angles to the pipe called the scraper bar, and chains run over the gear sheaves from the top of each handle, the scrapers being hung in pairs on adjacent rows of pipes. They are therefore balanced, and, by unbolting any sheave from its gear-wheel, any pair of scrapers can be adjusted by hand. They should be so set that all arrive at the top and bottom of their runs at the same moment. If 1 or 2 arrive ahead of the others, the reverse has not yet taken place, and the gears turn their sheaves with the full friction drag of the chain against it, so that the strain upon the reverse mechanism is very great, often enough to break off the cast-iron reverse horn. It takes 15 min. for the scrapers to make a complete course down the pipes and up again, so that the adjustment of the reverse to coincide exactly with the arrival of the scraper bars at the top of the economizer is a matter of hours of patient work, and it ought to be done by the erecting contractors before heat is put on the economizer.

The motive power for the scrapers is usually furnished by the general contractor or owner. The main scraper pulley does about 120 turns a minute, so that countershafting must be provided for it if a motor is used. I should never advise less than a 3-hp. motor, though 1 hp. is all that is called for by the makers. At first 1 hp. is ample, but each time you have a leak, a certain amount of hard boiler scale is formed on the tube by it, and when the scraper encounters that scale cake, it sticks, and no force under heaven can budge it higher. Of course this leak is sure to be on an inner tube, where the outside of the pipe cannot be gotten at. The leak is reported and you shut down, take off the tube cap and expand the tube tight. From that time on, that scraper will drag behind the others each time it encounters the scale cake and its chain will have to slip on the sheave until the reverse takes place, calling for additional horsepower for a short time from the motor. I know of one plant where they started with a 2-hp. motor

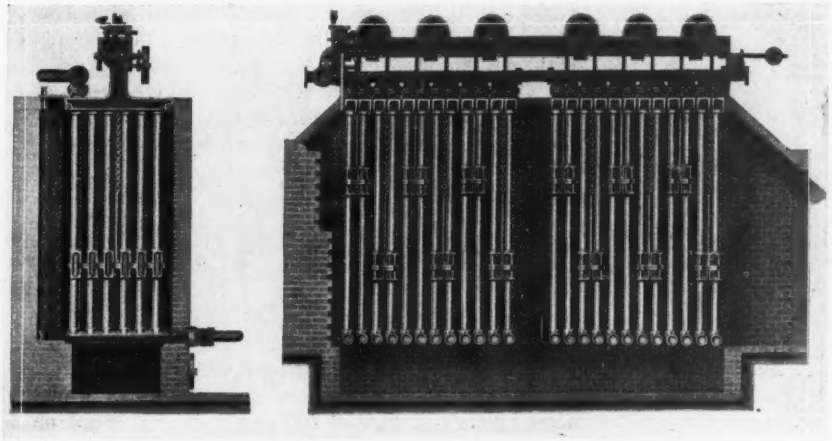


FIG. 4. SIDE AND END VIEW OF GREEN ECONOMIZER

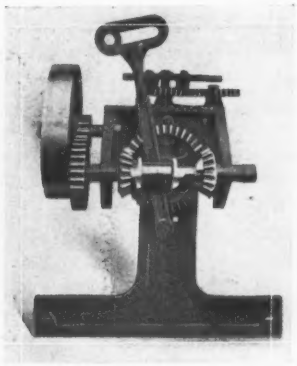


FIG. 5. REVERSE GEAR OF GREEN ECONOMIZER

*Continued from page 439, April 15 issue.

and ended with a 10 before the whole economizer was finally dismantled and given a thorough cleaning outside, after some 15 yr. of service. It was then re-erected and they started in fresh with a 3-hp. motor. As a rule, however, this size ought to last you 5 or 6 yr. In the matter of scraper mechanism, one well-known make has the scraper sheaves each operated by a worm and wheel, the worm shaft running lengthwise of the set of sheaves and the reverse clutch and horn only having to reverse this shaft, which in the nature of things has an

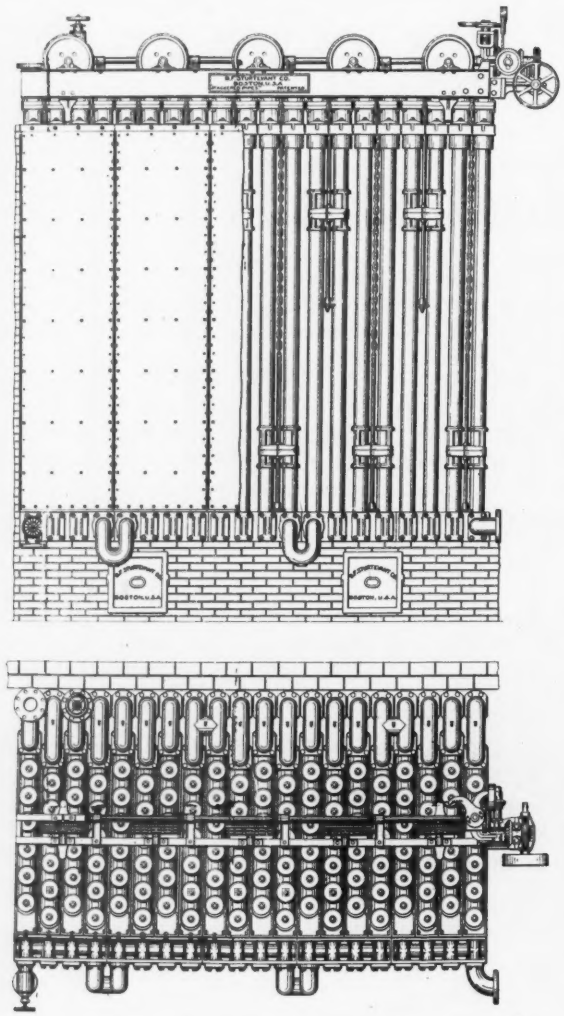


FIG. 3. PLAN AND ELEVATION OF STURTEVANT ECONOMIZER

easy torque so that it puts little pressure on the reverse clutch.. In another make, the scraper sheaves are actuated by bevel gears and the torque on this shaft is the addition of all the resistance of the scraper chains instead of only about one-fortieth as in the case of the worm and wheel mechanism. On this shaft are the double bevel gears and jaw clutch reversing mechanism, and the pressure on it is very great. The clutch collar therefore requires frequent heavy greasings and, at that, wears down very quickly, while the pressure with several stuck scrapers is sometimes so great as to break either the reverse horn or its lever. Between the reverse bevels and the main pulley is the worm-and-wheel which reduces the speed and increases the available torque; but it seems to be in the wrong place, for it should come after the reverse clutch so as to relieve the latter of the direct strain from the scraper sheaves.

Cleaning

About once every 6 months, with good clean city water of some 4 grains of solids in the U. S. gallon, it is necessary to shut down the economizer for about a week and clean and scrape all the tubes by hand. One of the great points claimed for the economizer is that it spares the boilers an immense amount of mud by precipitating it in its own tubes. You will find about 1/8 in. of it inside each tube, overlying 1/32 in. of hard boiler scale,—carbonates and silicates. You can tell when it is getting time to clean, by the steady falling off in feed-water temperature.

If there is room, the best way to clean out the mud is with a long-handled tube scraper. Each of the 400 tube caps comes off, and if it is a metal joint economizer they had better go in a tub of soft water at once to prevent rust on their seats. You will need a flushing hose to run the mud down the blowoff as fast as scraped. If there is no head room, a hydraulic turbine boiler tube scraper is best, with one of the soft tool heads on it. It does its own flushing. Next comes off the scale, and in a short time the blowoff valve is clogged and you have to take off the lower header caps anyhow. It is well to see that the architect provides drains to catch wash water in the design of his flooring when the plant is being built. In small plants most of this scale can be softened by putting in the softening compound, between the feed pump and the economizer, instead of just before entering the boiler as is usually the custom. In large plants with a water softening plant, this is usually so hooked up with the feed pumps as to insure the economizer as well as the boilers getting the benefit of the softened water.

Costs

The unit costs for economizer installation, as I have figured them out from a number of jobs, run about as follows for economizers from 1000 to 5000 hp.:—Economizer, $2.77 per horsepower; brickwork, 60 cents; dampers, 2 cents; sectional coverings, 13 cents; sheet iron, 8 cents; total $3.53 per horsepower. A 5000-hp. economizer will cost you about $18,000 complete, installed. With stack temperatures of 410 deg. and feed water from hot well of 200 deg., you can count on 60 deg. rise. For each degree rise in feed-water temperature the evaporation gains .1 per cent, or 6 per cent for 60 deg. Coal burned per day, 260 tons; 6 per cent of this is 15 tons, which at $3 a ton, fired, is $45. Figuring 75 per cent of your boiler plant putting out power, the actual saving would be about $33 a day. As the watertender of the boiler house looks after the economizer, it has no maintenance charges against it, and the horsepower charge is not over $100 yearly. Cleaning charges, 2 men, 4 weeks, twice a year; doing each of the 4 sections in turn—$320 a year. Repairs, about $60 a year. Total charges, say $500 a year. Saving in coal by economizer, $12,045, less $500 = $11,545; more than paying for it in 2 yr.

Operating Hand-Fired Boilers

ORGANIZING AND TRAINING BOILER ROOM FORCE; RULES FOR FIRING; IMPROVING GRATE DESIGN. BY J. C. HAWKINS

SOME time ago a plant with which the writer was connected had a hard boiler proposition. The load was very changeable, the feed water was bad and made a great deal of scale, the load was so heavy that all the boilers in their dirty condition were required to hold the steam pressure up; this made it necessary to clean one boiler partly and get it on the line again as soon as possible. The boilers, which had previously been fitted with chain grates stokers, which were taken out because they would not burn coal fast enough, or rather because they wasted too much, were fired by hand by a poor grade of foreign labor (the only kind that could be had for the wages paid) but a good grade of mine run Ohio coal was used.

The conditions had become such that the company had seriously contemplated installing an additional boiler to carry the load. The pressure carried was 150 lb., with the safety valves set at 155 lb. The greatest handicap was poor draft. The writer found that in order to get any results out of the plant, a complete reorganization of the boiler-room force was necessary, and after getting one set of firemen that would do as they were told (at least while being watched), several experiments were tried to increase the evaporation per pound of coal.

First, the water tender was shown the necessity of keeping the water level steady, and the feed water hot, and was instructed to keep it between 2 marks placed on the glass about 1½ in. apart, and to watch the thermometer on the heater and keep the water as near 211 deg., as possible, as there was sufficient steam to do this when properly handled. Then, during a few days of light load in the mill, the boiler cleaner was speeded up and one of the boilers thoroughly cleaned; that helped some. Then, after experimenting with different methods of firing, the following set of rules was adopted and posted in the boiler room, and the firemen were compelled either to follow them or get out. Rule 13 had caused quite a little trouble up to this time.

RULES FOR FIREMEN

1. FIRE often and only a small quantity at a time, and at regular intervals.

2. Break all lumps to fist size.

3. Carry level fire over the entire grate surface not over 6 or 8 in. thick.

4. Watch for thin and bare spots, and keep water in the ashpit.

5. Keep fires clean; when grates get plugged up, work the ashes through by working the slice bar back and forth on the grates, but do not break the clinkers up into the coal bed, and use the bar as little as possible.

6. Coal one half of the fire at a time. Do not fire the other side until the first side is hot. If you have any banks started, fire around them.

7. If the steam pressure drops, due to more load, fire lighter and oftener to keep the fire at a higher temperature.

8. When the load is light, keep the dampers partly closed, also when the boilers pop off. Keep the boilers from popping off as much as possible.

9. Keep the water level in the glass, and the feed temperature at 210 deg.

10. Each fireman shall watch the dampers on his own boiler.

11. In cleaning fires, one side of each fire shall be burned down as much as the condition of the load will permit, and after the clinkers are out, cover the grates with coarse coal and wing the fire back to that side. The fires must be cleaned at 6 a. m., noon, 6 p. m., and midnight when the load is off.

12. All fires must be "winged," i. e., all unburned coal must be pushed over to the other side before pulling the clinkers out, and the second side must not be started until the first side is burning well.

13. Any employe coming on duty under the influence of liquor will be liable to 10 days' suspension for the first offense, and discharge for second offense.

The dampers at this time were controlled by hand on each boiler, but later a damper regulator was installed, and set to close at 152 lb. A red lamp, placed in a conspicuous place in the boiler room and connected to the lighting circuit with a contact on the arm of the damper regulator, warned the firemen when the damper opened, and was a signal to fire one side of the furnace. This gave a much quicker notice of the variation in pressure than could be seen on the steam gage.

About this time an increase in wages of 2 cents per hour was granted which, although small, helped to get more steam out of the coal. The old grate bars became burned out, and a pattern was made for a new one of the herringbone type with ⅝-in. air space arranged to give as great air space as possible. These were found to be longer lived than the straight pattern. Shaking grates were out of the question in the office. The new grates helped the draft considerably. The soot was blown from the tubes every day; when a boiler was taken off for cleaning, the exterior surface was cleaned first, which was done by washing down with the hose. The cracks in the setting and around the doors were plugged up, and especial attention paid to the baffle walls. This was not all done at once, but required several months time; the result was that 5 boilers carried the load that 6 were required for before, and even then were loaded only a little over their rated capacity when caring for an increased output in the mill. The firemen's wages were increased a little and their working conditions made better. The firemen in this plant were especially trained to fill the existing conditions.

On several occasions men who had been locomotive firemen and also marine firemen were hired; while they were no doubt good firemen in their respective places, they were no good in that plant because with the poor draft they fired too heavy and soon banked the fire up. Later on, a 175-ft. brick chimney was built, which settled the draft problem. The coal used was high in volatile matter and the stacks smoked badly. Two of the furnaces were fitted with Dutch oven furnaces, and made a great deal less smoke than the others, part of which were equipped with steam jets in the front wall which automatically admitted air through a damper over the fire for a predetermined length of time after stoking.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Practical Electrical Engineering*

TRANSFORMER DETAILS. BY NORMAN G. MEADE

FIGURE 3 shows a cross-sectional view of a shell type transformer. The coils, c^1, are surrounded on both sides by a built-up, laminated-iron core, c, provided with ventilating spaces, V, which also aid the free circulation of oil. The laminations are stamped in 2 parts and are built up about the assembled coils, as shown in Fig. 4, where A, B and C are the divisions between the 2 parts of the top sheet, A^1, B^1 and C^1 the division of the next sheet to the top, and P-S the primary and the secondary coils. There are numerous patterns of laminations, but in building up any pattern the joints are always staggered, as shown in the figure.

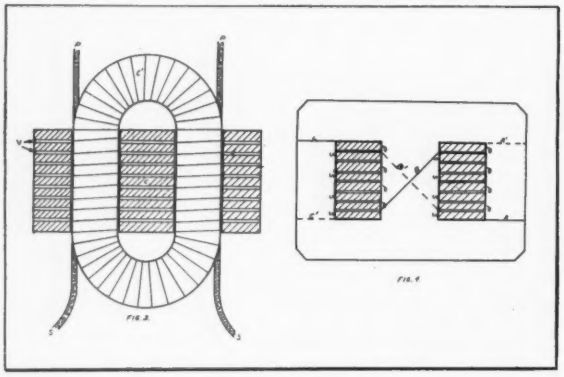


FIG. 3. LONGITUDINAL SECTION OF SHELL TYPE TRANSFORMER

FIG. 4. CROSS SECTION OF SHELL TYPE TRANSFORMER

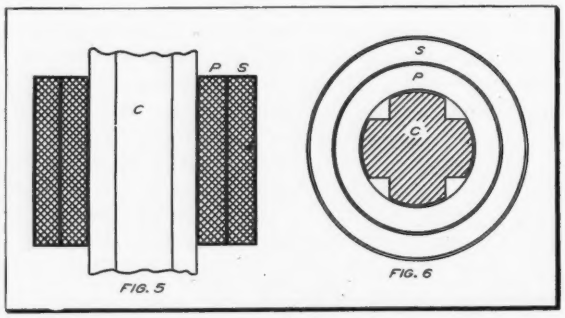
Not only are the coils thoroughly insulated from the iron core, but from each other. Various grades and thicknesses of insulation are used, depending largely upon the transformer voltage. Such materials as fiber paper, fuller board, oiled cloth and micanite are used. After the coils are wound and taped they are placed in a vacuum tank where an insulating compound is injected which thoroughly impregnates the windings.

Cross-sectional end and side views of one leg of a core type transformer are shown in Figs. 5 and 6. The assembly diagram of a core type transformer was shown in Fig. 2, a single-phase transformer having 2 legs and a 3-phase transformer 3 legs. In the figures P and S are the primary and the secondary coils, and c the laminated iron core, made irregular in shape to facilitate the circulation of oil within the coil. The manner of insulating and treating the coils is in every way similar to that of shell type transformers.

TRANSFORMER TERMINALS

ESPECIAL CARE has to be exercised in the design of high-tension terminals of a high-voltage transformer. Figure 7 shows a condenser terminal used by a leading manufacturer on oil-insulated, water-cooled and oil-insulated, self-cooled transformers of voltage classes exceeding 66,000, for indoor service.

In this terminal the voltage stresses are distributed equally throughout the material and not concentrated at



FIGS. 5 AND 6. VERTICAL AND HORIZONTAL CROSS SECTIONS OF CORE TYPE TRANSFORMER

the surface, as is the case with the ordinary type of terminal. The condenser terminal consists of a conducting rod surrounded by a number of concentric condensers of predetermined electrostatic capacity, arranged so that in effect they are connected electrically in series. The terminal is tapered toward the ends in steps, one step at the end of each metal layer.

By the arrangement of metal cylinders, the potential difference between them is fixed by the design and, hence, may be kept within the limit of puncture strength of the insulation. As the edges of each metal layer extend to the edges of the cylinder of insulation immediately surrounding it, the potential gradient along the surface is practically uniform.

TRANSFORMER OIL

CASES OF practically all types of commercial transformers, with the exception of air blast, are filled with oil when placed in service, which performs 2 important

*Continued from page 449, April 15 issue.

functions. It serves to insulate the various coils from each other and from the core, and it conducts the heat from the coils and core to some cooler surfaces, where it is either dissipated in the surrounding air or transferred to some cooling medium.

In recent years the oil itself in very large transformers is taken from the transformer when it is hot and is pumped through the coils and cores after it has been cooled external to the transformer It is evident that the oil should be free from any conducting material and it should be sufficiently thin to circulate rapidly when subjected to differences of temperature at different places. Further, the flash point should be exceedingly high.

Transformers of 100 kva. and above are frequently of the air-blast type and are kept cool by a forced circulation of air which acts to convey the heat from the transformer and dissipate it in the surrounding air.

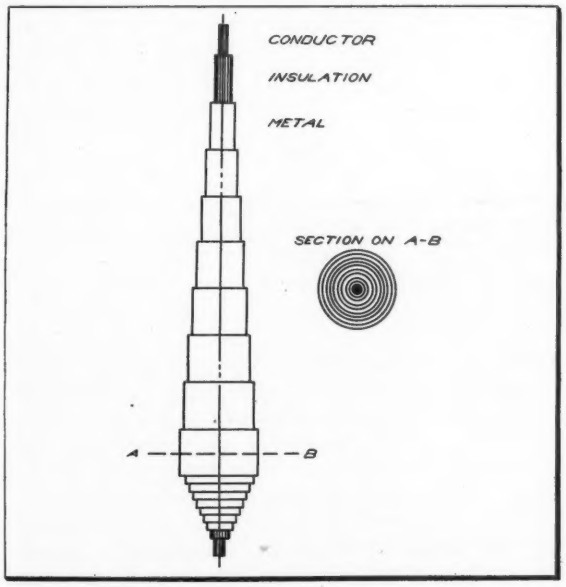


FIG. 7. CONDENSER TYPE TERMINAL BUSHING

Spaces are left between the sections of the core and the subdivisions of the coils and between the coils and cores and sufficient air at proper temperatures is forced through the ducts.

It is common practice to use about 150 cu. ft. of air a minute per kilowatt of loss, the air being forced through the transformer by a blower at a pressure of from 0.5 to 1.5 oz. per sq. in.

In other types of transformers the rate of cooling, or transfer of heat from the external surface of the case to the surrounding air, varies approximately with the product of the exposed surface and the temperature elevation. The normal exposed surface of the case of an oil-immersed transformer is not sufficient to provide the required radiating area for transformers rated at more than 25 kva.

Increase in exposed area is gained by using radiating fins on a cast-iron case or by making the case of corrugated metal. A convenient method for removing the heat from the oil is circulating cool water through pipe coils immersed in the oil of the transformer. The tubing is generally from 1 in. to 2 in. in diameter, the lengths depending upon the amount of heat to be carried away and the difference in temperature between the oil and the water.

AUTO-TRANSFORMERS

FIGURE 8 shows the circuits of an auto-transformer of the single-phase type. It has but one coil with certain

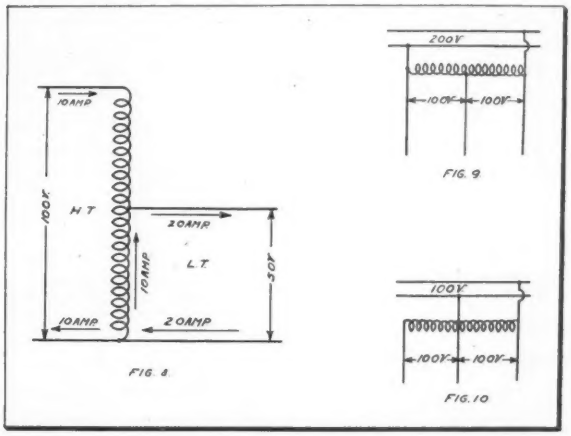


FIG. 8. AUTO TRANSFORMER FOR 2 TO 1 TRANSFORMATION
FIG. 9. AUTO TRANSFORMER USED FOR 3-WIRE DISTRIBUTION
FIG. 10. 1 TO 2 TRANSFORMATION WITH AUTO TRANSFORMER

portions of the windings used simultaneously as the primary and the secondary circuit. The number of turns is the same as though it were used exclusively for the high tension winding and a separate additional coil were used for the low tension winding.

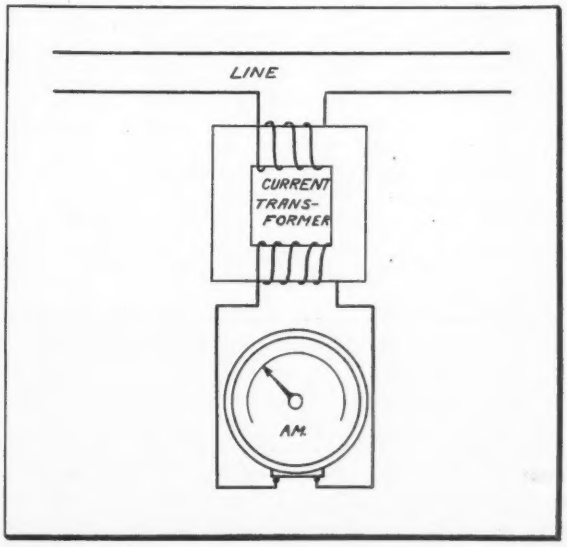


FIG. 11. METHOD OF CONNECTING CURRENT TRANSFORMER

By referring to the figure, it will be seen that one coil is designed for 10 amp. throughout and for a total of 100 volts. As the voltage per turn is uniform from end to end, it is evident that by making a tap at the

center of the coil, an electromotive force of 50 volts will be the result. The load current of 20 amp. is opposed by the 10 amp. primary current, so that in this section of the coil the resultant current is but 10 amp. Figures 9 and 10 show an auto-transformer arranged as a 2 to 1 and a 1 to 2 balance coil, respectively.

Current Transformers

For connecting instruments such as ammeters, circuit breakers of some types, relays, etc., to high-tension lines, current transformers are used to reduce the current to a low value that can readily be handled by the instrument and eliminate danger due to high voltage at the switchboard. In construction they are essentially the same as a shunt transformer with the exception that fewer turns of wire are required for the primary winding. The connections of a current transformer to an ammeter are shown in Fig. 11.

(To be continued.)

Installing Three-Point Switches

By Irving W. Booth

THE usual diagram for 3-point switches is that shown in Fig. 1. This may be called the standard connection. Almost invariably, when called upon to put switches on a finished job, it will be found wired this way. Another connection is shown in Fig. 2.

For several reasons, the standard connection is not the best. It is difficult to test out without running back and forth between outlets, as only one live wire appears at each switch. Then, a broken wire may put both out of business, and make it impossible to light the lamps at all.

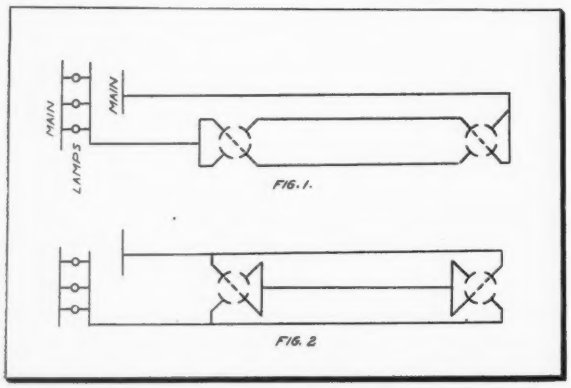


FIG. 1. USUAL OR SERIES CONNECTIONS FOR 2 3-POINT SWITCHES

FIG. 2. PARALLEL CONNECTIONS FOR 2 3-POINT SWITCHES

In Fig. 1 the connection is called the "series," because the circuit is open unless both switches work, as in any series apparatus. In connecting up, one live wire is taken to each switch and 2 dead wires run between. To connect, the live wire must be located by some kind of a test, and connected to the double point, the 2 dead wires going to the 2 single points. The usual test is to twist all 3 wires at No. 1 switch together, trip to No. 2, locate live wire. (Two dead wires have same polarity.) Then twist 3 together at No. 2, trip to No. 1, locate live wire, and install switches (one more trip).

The connection shown in Fig. 2 is called "parallel" from analogy, although the switch connections work in series. Both live wires appear at both outlets. The test is there as soon as the ends are scraped. Connect the 2 live ends to the 2 single points. The dead end goes to the double point. In case of a broken wire, the other switch may be used as a single pole. Sometimes when a job is completed, it is found that 3-point switches are not wanted, but 2 single pole, so that one man cannot turn out the light on another; i.e., either may light, but it takes both to extinguish. With this connection, the wires are ready for the single poles. Conversely, if a circuit is wired for 2 single-pole switches, they may be changed to 3-point by pulling a wire from one outlet to the other, if the wireman understands the "parallel" connection.

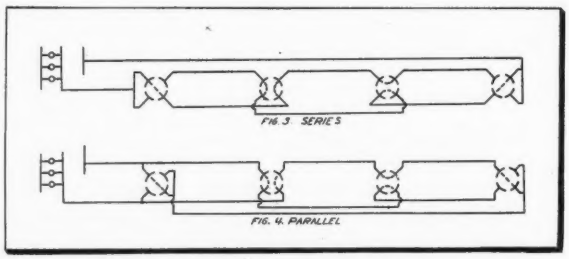


FIG. 3. SERIES CONNECTIONS FOR 2 3-POINT AND 2 4-POINT SWITCHES

FIG. 4. PARALLEL CONNECTIONS FOR 2 3-POINT AND 2 4-POINT SWITCHES

Only one wire is needed between switches. The other 2 wires are live wires and are routed to the switches in the shortest directions, often saving material and time.

Figures 3 and 4 show the same connections with 4-point switches, inserted. With Fig. 3, the usual series connection will require some elaborate testing out.

With Fig. 4, begin at No. 1, 4-point, where test is waiting, then install switch, proceed to No. 2, 4-point, and install that, for test is ready, then connect in the 3 points. No running back and forth. One or more single-poles may be installed anywhere desired.

A single-pole may take the place of either 4-point. The wires run through and the other switches act as usual, while the single-pole acts as a "safety"; i.e., lights cannot be extinguished until it is "off."

The illustration shows only 2 4-point switches, but any number may be used from one up and safeties installed, if wished. Safety should be an indicating switch.

Because of opposition from the National Association of Stationary Engineers to the plan of having the Pittsburgh Smoke Inspector either a metallurgical or mechanical engineer, the city council has been forced to postpone action of an ordinance providing for the position and fixing the salary. The stationary engineers think such a provision would be unfair to men who have learned all about boilers and furnaces by experience and study, but who may not have a college degree. The engineers say they ask for no preference to be shown, but are opposed to having college graduates given preference over practical men who may be more competent.

The Ice Plant Engine Room

PROPER FOUNDATIONS AND SIZES ESSENTIAL; PACKING THE AMMONIA PISTON ROD; REPAIRING AND OVERHAULING ENGINE ROOM MACHINERY. BY A. G. SOLOMON

THE engine room will contain the ice machines, light and power equipment, air compressors and pumps. Do not put the pumps outside in some unhandy, dark or dirty place. Have them where they can be watched and where the engineer can get at them for necessary regulation and repairs without leaving everything in the engine room to run by itself while he is doing so.

If it is a new plant and in course of erection, give the foundations a good bit of your attention. Have them big and heavy enough to withstand the strain to which they will be subjected. Do not try to save money by using inferior cement or any poor material, for the cost will be much greater if you have to tear out a foundation and put in a new one at some future time. When an ice machine foundation gets to moving or cracking, your troubles are sure to begin.

PROPER SIZES

NEXT, SEE that the machines you are putting on the foundation are exactly what you want. Do not get an ice machine entirely too big for the location, but also do not get one so small that you cannot supply the summer trade you figured on.

If it can be done, 2 smaller units should be installed instead of one big one. This is not advisable in a very small plant, but I have found that, in a plant of 50 tons or over, 2 units are better than one, both from the owner's and operator's point of view. In case of a break-down in a plant with only one compressor, you not only lose the day's output, but are likely to have to pull all the partly frozen ice out of the tanks or take a chance on springing leaks in the ice cans.

In the dull season and during winter, a small machine will give good service. Take a case like the following. A plant of 50 tons capacity will, during the summer months, give you from 52 to 56 tons a day. In cold weather, the demand will be for 10 or 15 tons a day.

If there are 2 25-ton machines, one can be shut down entirely and the other one run part of the time to supply the trade. In this way one-half of the plant can be overhauled first and then the other.

In case of a break-down, even in the middle of summer, the whole output will not be stopped for even a short time. The first cost of installation will be somewhat greater, but the investment will pay in the end. In this connection, it is a good plan to run each unit as an entirely separate plant, ammonia and steam condensers and ice tanks. Cross connections must be put in so that either machine can be used with any part of the other plant or the whole can be run together if so desired.

EXTRA PARTS

HAVE ON hand extra compressor valves, wedge bolts, and any other parts that are likely to break. Never let yourself be caught in the middle of summer with a broken valve, and the factory where they are made a thousand or even a hundred miles away.

PISTON ROD PACKING

IN REGARD to ammonia piston rod packing, most ice machines will run a season with the same packing and an additional few rings. There are cases (entirely too many) where the rods have to be packed every month, but in most of such cases there is a reason for this and it should be found and taken care of. The rod can be out of line either by the crosshead being too high or too low, or by the piston being low in the cylinder.

An inferior grade of packing may be used or the oil may be at fault. Another cause of packing failure is in the handling of the expansion valves. Sometimes the rod will be cold as ice and blowing ammonia and the engineer or some attendant will pull up on the gland till the leakage stops and then shut off some on the expansion valves; too much generally; and in a very few minutes the packing will be burning and a cloud of smoke following the rod full stroke.

Then the former process is reversed and the gland is slacked off ¼ in. or more, and the expansion valves opened to cool the rod. Once in a while, the man is lucky enough to strike the proper place between the 2 extremes, and the rod is scarcely looked at till the leakage or smoking begins again.

No packing can stand such abuse long; the rod also suffers unnecessary wear and in most cases bad scoring. You can be mighty sure that the machine is not doing the desired amount of work on the ice tanks with this continual change of feed.

Some machines, but luckily, not all, are equipped with a liquid line direct into the suction close to the compressor with an expansion valve to control the flow. When the compressor is not getting enough gas from the coils in the ice tank, it is common practice to use this liquid injection to cool the cylinder and rod. This is more often found in a plant that has the direct expansion system in the coolers or freezers, which are away from the engine room, and it required some one to take a few minutes' walk and perhaps there are some stairs or a ladder to climb. It is so much easier to give the compressor a little more nice, cool liquid through this most convenient line than to go to the freezers. Yes, it certainly is easier, but how much work is done in the place where it is required? Liquid injection of this kind should not be used except in case of absolute necessity, and then by someone who fully realizes what he is doing.

When the gland has to be slacked back, do not overdo it. Just about 1/16 in. at a time is plenty, then wait a little while till the packing has time to adjust itself, then slack a little more. The habit of slacking a gland ¼ in. at once is a good and sure way to ruin the first 2 or 3 rings of packing, as those rings will expand at once and the ones in the back of the stuffing

box will not have a chance to expand at all. This damage to the outside rings will be readily seen when packing a rod. They will be found to be frayed and ragged, while those farther back will be fit to use again.

Packing a deep stuffing box with high-priced packing 3 or 4 times a season is a big addition to the cost of making ice, so care must be taken to do this job right.

If sectional ring packing is to be ordered, be sure to caliper carefully the rod diameter and the inside diameter of the stuffing box. Then, when you receive the packing, try a few rings, at the first opportunity, and see that no mistake has been made either by you or the manufacturers. Good grade packing should be just a nice, easy fit in the box. If it is found necessary to drive it in with a hammer, do not use it, as it will cause you trouble and will not last. The ends of the rings will be found to lack from 1/16 to ¼ in. of meeting, according to the size of the rod and style of packing used. This space allows for expansion and must not be neglected.

The rod opening in the compressor head should be just a clear fit and no more. It is best to have a babbit bushing at this place, which can be replaced by another when the rod is turned down. The oil sleeve or lantern must be made to fit snug in the stuffing box and should be babbited and bored out a scant 1/64 in. larger than the rod. The gland can also be babbited, as it will save the rod from being scratched in case the gland is not pulled up square. An ammonia rod expands so little in diameter when hot, that allowance is rarely made for it.

Oiling the Piston Rod

Be sure that the oil sleeve is in the proper place, so that the oil will enter it. When packing the rod, measure to the oil openings and have them come in the center of the sleeve.

There are several good ways of putting oil on the ammonia rod, but a great many of these ways use too much oil and fill the entire system. No matter how you arranged your oil supply and feed, do not use a bit more oil than you have to; you do not want oil in the ice tank coils where it will make a good insulation on the inner surface.

All machines have some arrangement to draw the oil out after it has done its work on the rod and in the cylinder. A big part of the oil will settle in the discharge gas receiver, from which it should be drawn every day or two, or as often as your observations tell you it is necessary. Measure the oil you use and also the oil you recover; try to see how nearly you can come to getting the oil back, and in that way, not only save on the oil bill, but also keep the system clean. All ammonia oil recovered should be filtered and used over again, just the same as the engine oil.

Pipe Covering

Ammonia suction lines should be properly covered, also the liquid receiver and liquid lines if they are in a hot engine room. In such a place, where a liquid and suction line run a long distance and to the same place, they should be covered together; the liquid will be benefited by giving up some of its heat to the suction line.

Scale traps and screens are almost a necessity in a new plant. Scale and dirt will come from the inner surfaces of the ice tank coils and ammonia condenser, and if not caught, this fine, hard scale will soon cut the compressor valves and cause them to leak and in many cases the cylinder will be scored.

Checking Capacities

Know the displacement of the ammonia cylinders and compare this with the capacity arrangement of the other parts of the plant. The displacement will always be the same, but the weight of gas handled varies with temperature and pressure, and that is what counts in figuring the compressor capacity.

Theoretically, the closer the back pressure and condenser pressure are to each other, the more work done. This is undoubtedly true, but does not give the desired results at all times and under all conditions. In a cold climate, the condenser pressure sometimes gets too low and the cooling water will have to be partly shut off or the ammonia will be so slow that work cannot be done till the pressure is raised; and the arrangement of the piping in the ice tanks will have a lot to do with the pressure that has to be carried on the low side.

Study all parts of the plant and you will soon find which pressures give the best results; try to keep the decided pressures as steady as conditions will allow. Study the machine and decide how close to the compressor the frost line should be carried to get the best work. On some machines the frost is carried heavy on the suction valves of the horizontal type or on the bottom of an upright compressor, while on others the suction line and bottom of cylinder will not be cool enough even to sweat.

The practice advised by some builders, of having the suction gas pass through the storage tank of distilled water, seems to meet with general approval. With this arrangement, it is almost impossible to freeze the machine.

Thermometers in both suction and discharge lines at the compressor are valuable in running the plant, as conditions can be noted much more readily and exactly than by the pressure gages.

Overhauling the Compressor

During the overhauling of the plant, the machine should be dismantled and everything carefully looked over. All compressor valves, cages and false heads must be made tight by grinding in with fine emery and oil. Piston rings must not be allowed to go another season if they are not so good a fit as they should be. If the ammonia cylinder is scored at all, it should be bored out. The clearance should be small as possible and this means, on a single-acting compressor, that the piston should travel to within 1/64 in. of the top head when the ammonia rod is what you consider a running heat.

On a horizontal compressor, when setting the clearance, it is proper to give the head end the most as the rod will lengthen some when warm. Do not forget that lost motion in the main bearings and crank and crosshead brasses will increase the clearance in the ammonia cylinder.

Give the air compressors and pumps and any other machinery just as careful attention during the overhauling season as you give the ice machines.

In a plant having one ice machine with 2 ammonia compressors, one side can be overhauled at a time and the other side can be operated. This is often done.

Downing A Big Stack

METHOD EMPLOYED FOR DROPPING A STACK 190 FT. BY 26 FT., INTO A 50-FT. CIRCLE. BY D. BOYD-SMITH, JR.

FOR the last 2 yr. the stack for the Roaster building of the McGill plant of the Steptoe Valley Smelting & Mining Co., at McGill, Nev., has been in a bad condition, due to the action of the acid in the smoke handled. This action has continued slowly, but none the less surely, due to the untreated bore of this stack, for some time past, and through its eating effect on the brick, had caused parts of the stack to fall; these parts, in some cases, fell inside and either stopped the draft entirely or so impaired it that other arrangements had to be made to take care of the smoke until the debris could be removed. Finally, the conditions reached that point where it was deemed advisable to build a new stack. This work was started and completed under the direction of S. S. Sorensen, then chief engineer, and under the direct supervision of Alma Ek, as engineer-in-charge.

On the completion of the new stack and its successful operation, it was decided for safety to destroy the old one and this work was given to J. D. Watson, civil engineer for the company, under whose supervision the plans were laid and successfully carried out as herein described.

The stack was originally 250 ft. in height, with an inside diameter of 18 ft., the thickness of the walls varying from 13 in. at the top to 50 in. at the bottom.

At the time of its destruction, the stack had been eaten away until it was only 190 ft. high, with a thickness of approximately 10 in. at the top, and it is quite logical to expect that the same amount of decrepitation had taken place on the inside throughout its entire height.

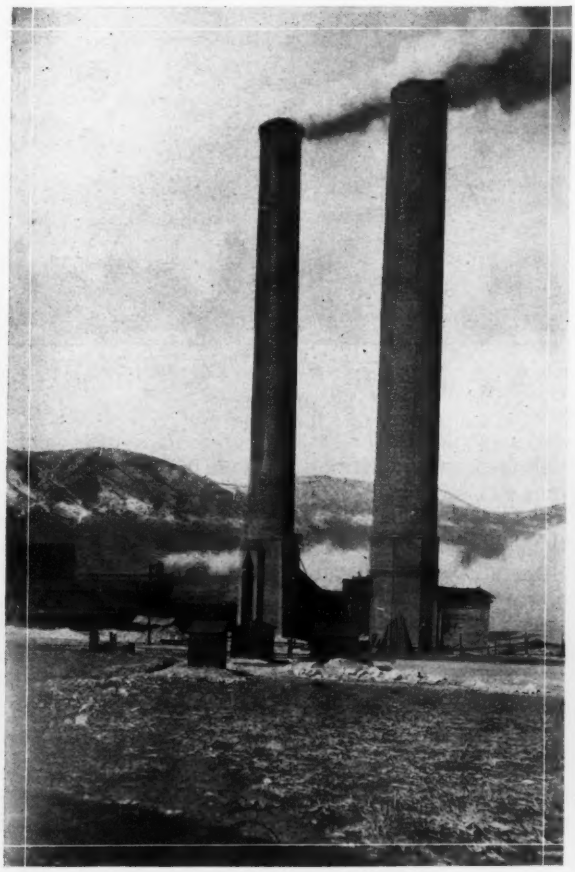


FIG. 1. THE OLD AND NEW STACKS BEFORE THE BLAST

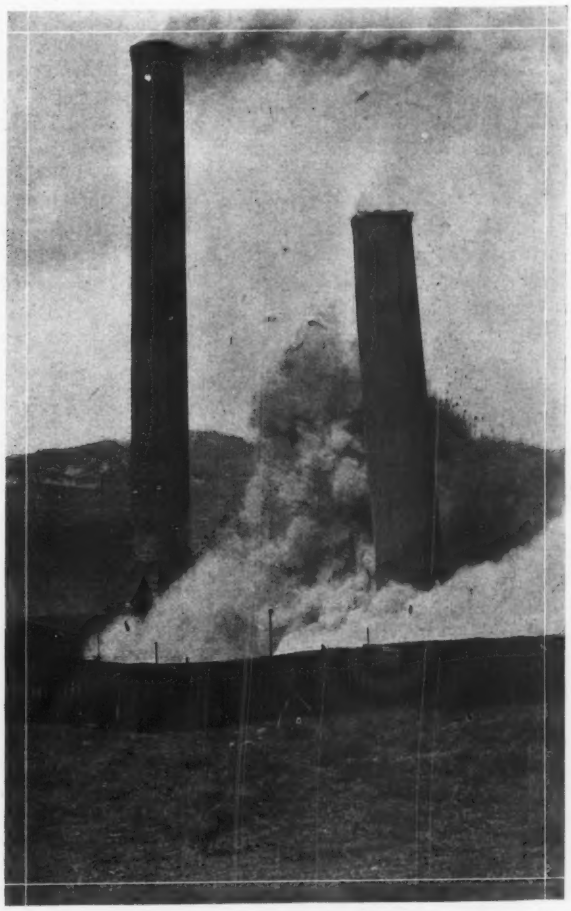


FIG. 3. AFTER THE SHOT, WHILE THE STACK WAS DROPPING

On the south side of the stack and 20 ft. above the concrete foundation, there was an opening 10 ft. wide and 15 ft. high, from the top of which started a series of cracks ranging from 10 to 50 ft. in length and extending to the top. The north and east sides were in a condition approximately the same as the south. The west side, however, showed a considerably worse condition than any of the other 3.

At the time of its destruction, the stack was estimated to weigh approximately 2,016,000 lb. and figuring on this weight, the following method of dynamiting was decided on by Mr. Watson as best suited to give the most satisfactory results.

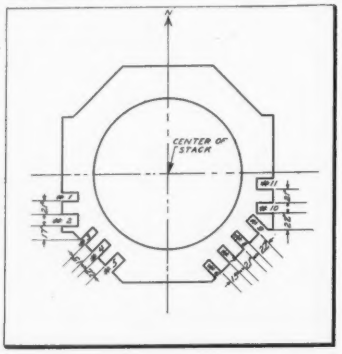


FIG. 2. LOCATION OF DYNAMITE IN THE BASE OF STACK

Eleven holes were drilled 7½ ft. above the concrete foundation, as is shown in the sketch, and of the sizes from 9.5 in. sq. and 22.5 in. deep for No. 7 to 24 in. wide, 6.5 in. high and 24 in. deep for No. 5, averaging 12 by 9 by 24 in.

It was decided that approximately 200 lb. of Hercules E. L. F. 40 per cent would be sufficient to do the work and how well calculated the amount was is graphically shown by the illustrations. The holes were loaded in the following manner:

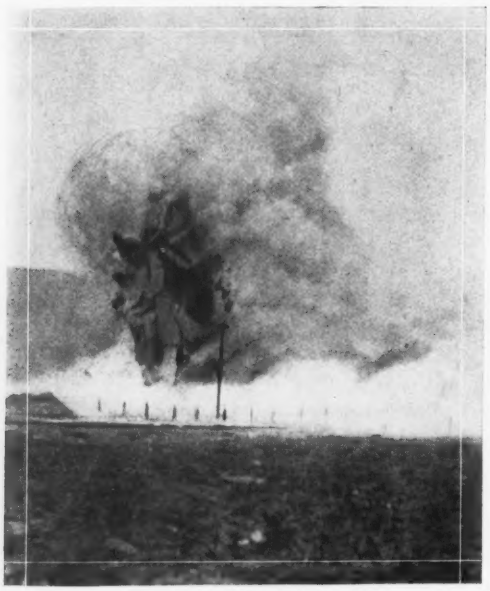


FIG. 4. AS THE UPPER PART TELESCOPED

Each hole was first loaded with its apportioned share of powder, in the middle of which was a stick containing an electric detonator with a 35-ft. lead. The detonator was inserted about 3 in. into its stick of powder. After each hole had been loaded in the manner stated above, great care being taken to see that the powder was in a compact mass, a black plastic converter mud was used to wad the holes. This was tamped thoroughly around the powder and thence on out to the surface of the stack, making in all a very solid charge. The amounts of powder placed in each hole varied from 8.5 lb. for No. 7 to 34.5 lb. for No. 6, averaging 15 lb. per hole and totaling 190 lb.

Electrical connections for the 11 holes were connected in series and then to a line running approximately 500 ft. to a switch connected to the 110-volt lighting circuit. This switch was equipped with plug fuse cutout and the fuses were not put in until the last minute, in order that under no condition would there be an accident due to premature explosion.

Everything being in readiness, the word was given and Master Floyd Middagh, son of Chief Electrician Middagh, closed the switch that set off the most successful shot of its kind ever seen by the many engineers who were present.

FIG. 5. AFTER THE DUST SETTLED; NOTE THE CLOSE PILING OF THE DEBRIS

From pictures taken at the time, it seems that the shot blew out the entire base above the concrete foundation and up about 30 ft. The stack then fell straight down until its lower edge hit the foundation, at which time it seems to have telescoped on itself, making one of the most spectacular and successful falls on record. The entire stack fell in a pile about 50 ft. in diameter, with the exception of a few brick which scattered to a distance of about 80 ft., due chiefly to the force of the explosion.

The new stack, located 145 ft. west by south, and the 2 oil reservoirs, located 100 ft. north by east, were not damaged.

A SERIES OF tests is being conducted by the University of Illinois for the Scullin-Gallagher Iron & Steel Co. of St. Louis, on a new style of car coupler which is believed to be an improvement over the coupler now in use.

The weak point of most car couplers now in use is the face, this being the place where fracture generally occurs. The new style of coupler eliminates this difficulty by having a solid face and a new type of tail knuckle. A former test made by the University, showed that when failure of the new style coupler occurred, it was generally at the knuckle. After the first tests, the design was changed so as to add about 15 lb. of metal to the knuckle. The new design is now being tested under the supervision of Prof. J. M. Snodgrass of the Railway Engineering Department.

Foreign Development in the Power Plant Field

GRAPHITE LUBRICATION; NEW COMBUSTION SYSTEM; BALANCED STEAM VALVES. BY J. H. BLAKEY

USE of graphite for the lubrication of motors is sometimes unsatisfactory, because of the difficulty of introducing it at the proper place. The necessity of having the graphite in the form of a very fine powder increases this difficulty. Lubrication with a mixture of oil and graphite solves the problem, provided that the mixture is perfectly homogeneous. This homogeneity has been reached in a preparation called "oildag," in which artificial Acheson graphite is emulsified with oil by the use of tannin. The combination is so perfect that the graphite cannot be separated, even by filtering. It is claimed that this oildag, mixed with lubricating oil, reduces frictional resistances 60 per cent more than when oil alone is used. Under the name "Schwebegraphit" there is manufactured in Germany a similar compound in which Styrian and Italian natural graphite is used, the material being rid of foreign matter until it is 99.5 per cent pure carbon.—Bulletin Soc. d'Encouragement.

THERMAL EFFICIENCY OF BOILERS HEATED BY THE BONE SYSTEM

IT MAY be remembered that some years ago, Prof. Bone, of Leeds, England, brought out a system of flameless combustion which promised great results in increasing the thermal efficiency of boilers. His experimental boiler gave an efficiency of 94 per cent, and it was believed that this might be reached under ordinary conditions of practical working.

In a recent number of Stahl und Eisen, M. Neumann gives the results of some tests of this method in Germany. It appears that it has been discovered that a strong draft is necessary for the successful operation of boilers heated in this way, on account of the close packing of the refractory material used in the heating tubes. This refractory material plays the part of a catalyser, facilitating combustion, which is perfect, even with a small excess of air. The necessity of maintaining a vacuum in the chimney sufficient to create this strong draft naturally brings down the efficiency considerably, which with coke furnace and blast furnace gas, is found to be 88.4 and 85.3 per cent, respectively. The author expresses the belief that this may be increased by an improvement in the method of packing the combustion tubes.

THE ANDREWS AND CAMERON BALANCED STEAM VALVE

THE ANDREWS AND CAMERON balanced valve, recently patented in England, allows the admission of large quantities of steam and reduces to a minimum the losses which frequently occur in the ordinary valve. Figure 1 shows a valve of this kind with double opening. It will be seen that the passages are large and free from obstructions. The escape is equal in length to the travel of the valve. Steam in the cavities A, B and C maintains the balance and keeps down friction. The steam and exhaust ports are always entirely free, and the steam never strikes any part which may become abraided, as occurs sometimes with other valves, especially those distributing steam at low pressure and containing much moisture.

Figure 2 represents a triple-opening valve. In this arrangement, the saddle is furnished with a supplementary channel connecting the 2 extremities of distribution. There is thus a third supply of steam to the cylinder. Moreover, when the valve is at the middle point of its stroke, at the moment when the distribution is about to change direction (Fig. 3), it will be seen that the 2 extremities of the cylinder are in communication, so that the free space is filled with steam from the previous exhaust, which allows a high compression in cylinders using low-pressure steam. This supplementary channel, in fact, makes sufficient dimensions, which, without it, would be too small.

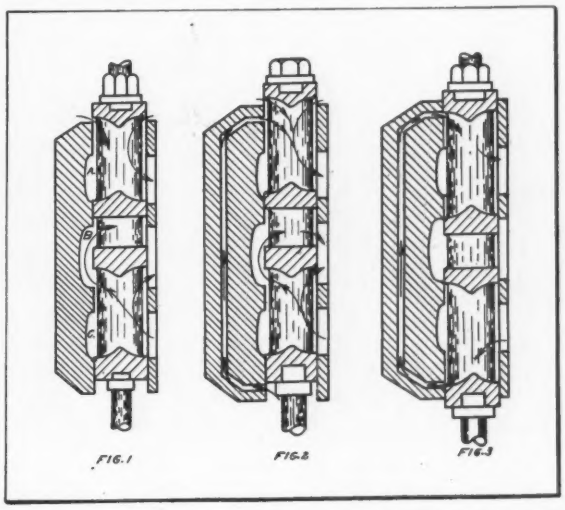


FIG. 1. ANDREWS AND CAMERON BALANCED VALVE WITH DOUBLE OPENING
FIG. 2. VALVE WITH TRIPLE OPENING
FIG. 3. TRIPLE OPENING VALVE IN MID POSITION

The application of these valves to the triple expansion engines of the English steamship "Tweed," has increased their power from 1315 to 1397 hp. They are in use also on a number of French steamships.—Le Genie Civil.

THE HYDRAULICS LABORATORY of the University of Illinois has just added another piece of apparatus to its equipment. There is being installed a 4-in., 3-stage De Laval centrifugal pump, to be driven by a 50-hp. Westinghouse variable speed induction motor; it will be capable of giving a discharge of 275 gal. per min. against a head of 400 ft. The pump will be arranged so that water can be drawn from the laboratory standpipe into the pump and in this manner the total available head of 450 ft. can be had.

Panama Exposition Grounds of Today

MACHINERY PALACE PRACTICALLY COMPLETED, WORK ON OTHER STRUCTURES PROGRESSING RAPIDLY

SOME of the glories of the huge Panama-Pacific International Exposition, to open in San Francisco in 1915, are revealed in the accompanying illustration, which shows a part of the main exhibit section. The picture was taken from the south side of the grounds and on the extreme left is seen the exposition fence. The large group of buildings seen clustered on the right lies between the south gardens and an elaborately landscaped marine boulevard on the shores of San Francisco harbor. As will be noted, the exposition lies in a great natural amphitheater, encircled on the south, east and west by the hills of San Francisco and the wooded slopes of the Presidio reservation, part of which are seen in the background.

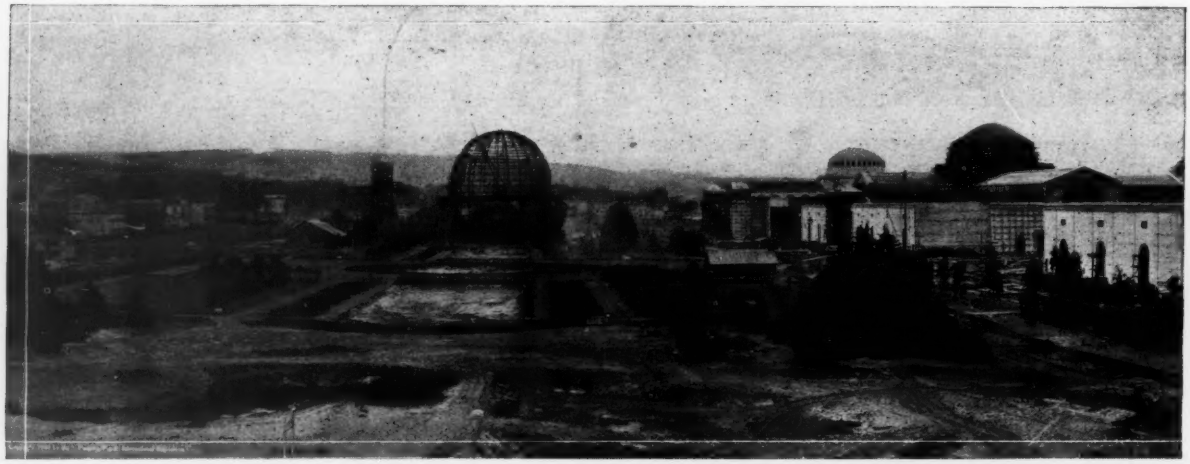
This photograph was taken at a considerable elevation and so does not reveal the great height of the buildings.

The large steel frame seen in the center of the gardens is that of the dome of the huge Palace of Horticulture; this dome is 186 ft. in height and 152 ft. in diameter; when completed, it will be covered with glass and at night, colored searchlights will play upon the glass from within, giving the dome the effect of a gigantic soap bubble, sparkling in all the colors of the rainbow.

In the foreground before the Palace of Horticulture is seen a part of the south gardens, which will be marvels of tropical transplanting. A few of the trees to be used in this section may already be seen in the photograph. Directly before the Palace of Horticulture are many teams, so small as to be almost invisible.

The large group of buildings on the right consists of 8 exhibit palaces, 4 of which face on San Francisco harbor and 4 border upon the south gardens. The buildings facing the south gardens and forming a continuous east and west facade are, left to right, the Palace of Education, Liberal Arts, Manufacture and Varied Industries. The palaces facing the harbor, are those of Food Products, Agriculture, Transportation and Mines and Metallurgy.

The large white dome at the left is that of the huge Palace of Education; this dome is 160 ft. in height and 100 ft. in diameter. The next dome, which is of similar proportions, and which has not yet been painted, is that of the Palace of Liberal Arts. And next, behind the dome of the Palace of Liberal Arts, may be seen the dome of the Palace of Food Products. The next building to the right and prominent in the picture is the Palace of Manufactures, on which the dome has not yet been superimposed. The cross naves in this palace, at the intersection of which the dome will be placed, are 110 ft. in height. The next dome seen is that of the Palace of Transportation; at the extreme right of the picture appears one corner of the Palace of Varied Industries. In the opening in the center of the group and to the right of the first 2 domes, will be located the huge Tower of Jewels, which will rise in superb terraces to a height of 433 ft. The tower will be cleft by an archway 125 ft. high, through which visitors will enter from the main gates of the exposition into the court of honor, the Court of the Universe.



LATEST VIEW OF THE PANAMA-PACIFIC INTERNATIONAL

Thousands of men are now at work on the exposition grounds and construction is proceeding with unparalleled rapidity, and all exhibit palaces will be ready to receive exhibits on July 1 of this year.

MACHINERY PALACE

THIS STRUCTURE, covering a floor space of about 8 acres, one of the largest wooden buildings in the world, is specially adapted for housing an exhibit of the world's most important machinery, and will be ready for exhibit July 1, 1914, so that there is ample time for the installation of exhibits before the opening of the exposition on Feb. 15, 1915.

At the present time, the building is being used as a studio for the preparation of the mural paintings, which are to adorn the walls of the various exhibition buildings. Installations of heavy exhibits can be commenced immediately after July 1, 1914, and may be consigned directly to the spaces in the building which they are to occupy. The Machinery Palace will be provided with water, gas, compressed air, steam, light, electric and overhead crane service, sufficient for the use of all classes of exhibitors.

There is no charge for exhibit space, but space occupied must be properly and economically utilized. Exhibits are transferred by the Exposition Terminal Railway, from the terminals of railway and steamship lines, at a charge of 15 cents per 100 lb., and this company will arrange, at Chicago and other eastern points, to receive less than carload shipments and combine them into carload lots, to be shipped direct to the exposition, thus securing carload rate.

Water will be supplied on a meter basis, the rate for ordinary domestic purposes being 40 cents per 1000 gal., with a minimum charge according to the size of meter installed. For other than ordinary domestic purposes, special rates will be given for water.

Electric service will be supplied at 115 volts, 60 cycles, 3-phase, alternating-current for lighting, at approximately 230 volts, 60 cycles, single or 3-phase for alternating-current power, and at 125 and 250 volts direct current for power. General illumination will be cared for by the Exposition Company, and exhibit buildings will not be open at night nor on Sundays. Single-phase motors must not be over 1 hp., at 115 volts, nor over 5 hp. at 230 volts. Direct-current motors must not be larger than 25 hp. for 250 volts, nor 2 hp. for 125 volts, unless arranged for in advance by special contract. Rates for electrical service for operating moving machinery, will be charged by meter at 3 cents a kilowatt-hour.

Gas will be supplied by meter at $1 per 1000 cu. ft., up to 50,000 cu. ft. a month, and at 80 cents per 1000 cu. ft. for consumption in excess of that amount. A minimum charge will be made to the size of the meter installed.

Saturated steam, at 150-lb. pressure, will be available during the hours that the building is open to the public, headers and mains for live steam, exhaust steam, drips and drains being installed by the exposition. Those exhibitors requiring steam must arrange for service in advance. The price for steam will be actual cost to the exposition company, the rates to be fixed as soon as the elements of cost have been determined.

Compressed air at 80-lb. pressure can be supplied to a limited extent; but such service must be arranged for in advance, and the charge will be $4 a month per horsepower of maximum demand of the installation, 1 hp. being considered equivalent to 5.5 cu. ft. of free air per minute, and in addition, 15 cents per 1000 cu. ft. of free air consumed.

In the main bays of the palace, crane service will be provided by electric overhead traveling cranes, 2 30-ton cranes traveling the center bay, and one 20-ton crane in each of the outside bays. Crane service for erection may be secured at a moderate charge. The clear head room below rails of the traveling crane for the 3 central bays is 50 ft., and for the wing bays, 40 ft.

EXPOSITION GROUNDS TAKEN FROM THE SOUTH GARDENS

Working exhibits, which can furnish part of the requirements of the exposition for power or other service, will be compensated at regular rates.

The floor of the building is designed to carry 200 lb. per sq. ft., and consists of 2-in. plank on joists carried by mud sills. The building is located on ground well adapted for foundations, which must be provided by exhibitors, if required. No line shafting will be permitted in the building. Applications for exhibit space will be given precedence according to date of receipt, blanks for such applications being available from the officials of the Panama-Pacific International Exposition Co., Administration Dept., San Francisco, Calif.

Near the Palace of Machinery, in a separate building, there will be the Gas and Fuels Building, which will house exhibits of boilers, steam hammers, gas producers and other appliances, which, because of the noise of operation, cannot well be taken care of in the main building. A collective, combined exhibit of a number of exhibitors may be made, thus reducing the expense of attendance and installation.

GAS POWER APPARATUS

Producers, Engines and Industrial Applications

Development of Diesel Engines

FIELD FOR DIESEL MOTORS, PRINCIPLE OF OPERATION, COMPARISON OF 2 AND 4-CYCLE TYPES. BY C. VAN LANGENDONCK

DR. RUDOLPH DIESEL, of Munich, introduced the Diesel principle some 20 yr. ago. At the time in question, the internal combustion engine was occupying the attention of engineers as being an alternative to the steam engine, which then held supreme sway. The great drawbacks in internal combustion then known were the poor mechanical efficiency, the impossibility of building them in large sizes, and other disadvantages in practical service. The new type of motor being a practical engine, it soon became a real commercial asset, and, at the present time, the power developed by Diesel engines exceeds 1,000,000 hp.

The use of the Diesel motor extended specially rapidly in regions where water powers are not available for the operation of prime movers, and this rapid extension is due in large part to its relatively low costs of fuel consumption. The combustion being complete, there are no ashes nor any solid residue. Another point operating in its favor is the simplification of the installations, and their relatively small space requirements, the latter point being of prime importance above all in electric central stations; it does not require any boilers nor gas-producing plants.

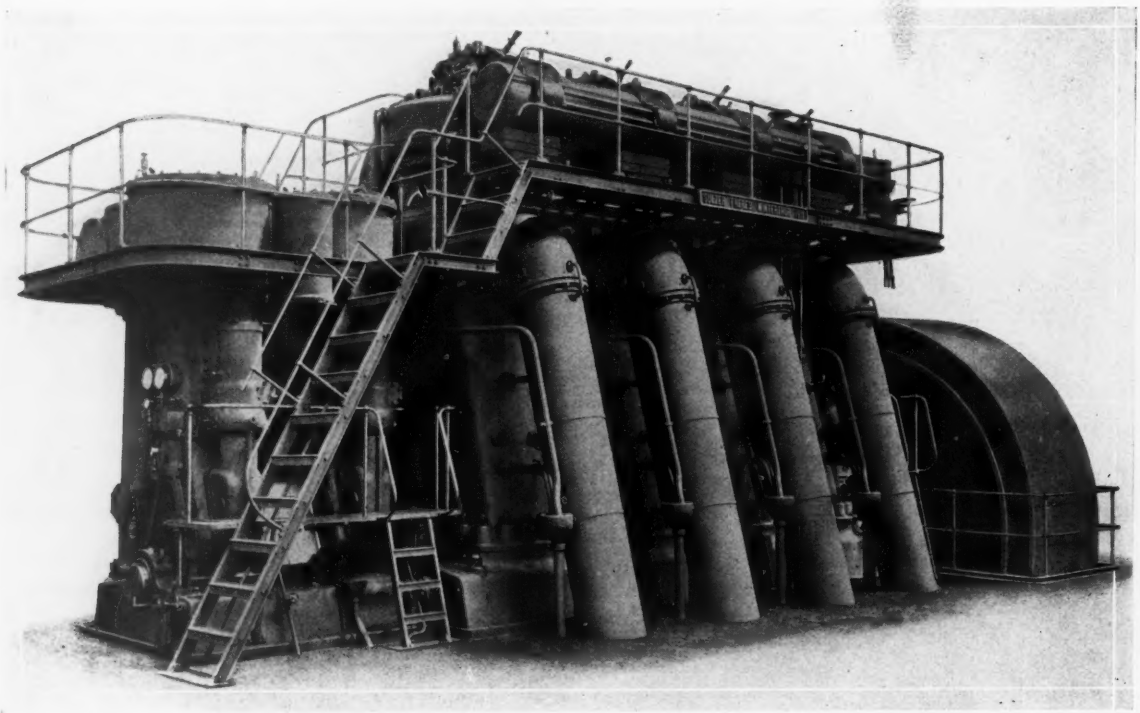


FIG. 1. TWO-CYCLE SULZER DIESEL ENGINE OF 2400-HP. CAPACITY

A great field for Diesel engines for electric power generation has been in auxiliary or stand-by installations in hydro-electric stations. Its fitness for this service is due to the inherent features of the engine,—that it can be started in a few moments, and no stand-by losses are incurred when the engine is not in operation. A further advantage is that there is no risk of explosion nor danger of fire, crude oil not being inflammable; as a matter of fact, a burning match may be thrown in it without harm.

The number of men required to attend to the plant is small and the supervision easy; no special knowledge is necessary. The efficiency of the engine does not depend upon the skill of the men working it, as is the case, for instance, with boilers.

The very regular running of the Diesel engine permits the parallel running of alternators. Variations as to loads, even when sudden, affect the speed only to a slight extent.

The Diesel cycle is now well known, but some words as regards the difference between the Diesel engine and the ordinary explosion engine may here be of interest. When a practically homogeneous mixture of gas, or hydro-carbon vapor, and air is ignited, the propagation of the flame throughout the entire mass is almost instantaneous, with a consequent sudden rise in pressure and temperature. The heat generated is therefore all added to the mass at once before it has time to expand, and this is practically what constitutes an explosion, as in the ordinary gas and oil engines, where ignition is obtained by electric or hot bulb devices.

In the Diesel engine, on the other hand, air and air only is drawn into the cylinder on the suction stroke of the piston, this air being compressed on the return or up-stroke. The fuel is injected into this air—already heated by compression—in a gradual manner, and in the form of a spray, during a greater or less portion of the working stroke, while the compressed air is expanding at a constant temperature. Gradual combustion, with the consequent absence of shocks and sudden strain, is obtained and is essentially and exclusively part of the Diesel cycle, and is the fundamental difference between this and all other internal combustion engines.

Injection and burning of the fuel oil can be so arranged that for all practical purposes the expansion of the gas takes place at a rate which exactly compensates for the piston displacement; thus whilst the fuel valve is open, the pressure is constant. Until recently, the Diesel engine worked only on residual petroleum; but it is now adapted to run on tar oils, and thus another wide field for the supply of fuel is opened up.

Power generated by Diesel motors of various types varies within wide limits, running from 20 to 3000 hp. and even more. The motors are of single or multiple-cylinder form, and of 2-cycle and 4-cycle type. With fuel having a calorific power of 10,000 calories and under normal load, the consumption is from 0.4 to 0.55 lb. per brake horsepower and per hour, varying with the size and type of the motor. The 4-cycle type is in most general use, because it was the original form and is most economical in fuel consumption. It is usually considered that the limitation of this type, single-acting, is 150 to 160 hp. per cylinder. Owing to the action of the scavenging air, the 2-cycle type can be carried up to 700 or 800 hp. per cylinder, single-acting.

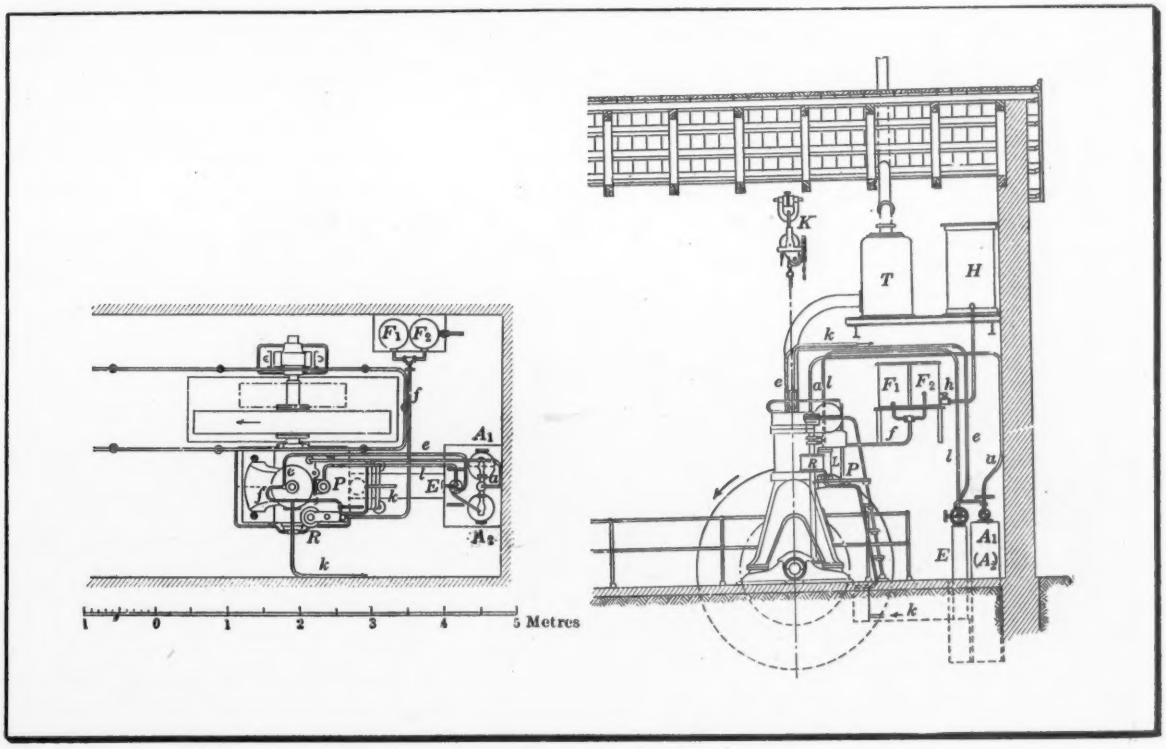


FIG. 2. GENERAL ARRANGEMENT OF A DIESEL MOTOR OF 40-HP. CAPACITY

The accompanying drawing shows the typical arrangement for a Diesel motor installation of 40 or more horsepower, including the motor itself, its accessories and the other details of equipment. As shown by the lettering, the motor accessories include: Compressed air reservoir, E, containing the air for injecting the combustible into the cylinder; compressed air pipe, e; 2 compressed air reservoirs, A_1 and A_2, one being a reserve, containing compressed air for starting the motor; the starting piping, a-a; pipes connecting the air reservoirs, E, A_1 and A_2 to the air compressor; 2 fuel reservoirs,

F_1 and F_2, one being provided with a filter; a fuel pipe, f-f, between these reservoirs and the motor; a muffler, T.

The accessories to installation which, of course, may be varied somewhat according to circumstances, include in this case: The principal reservoir, H, for storage of fuel oil inside the engine room; the fuel piping, h, connecting this reservoir with the reserve tanks, F_1 and F_2; exhaust piping, t; cooling-water piping, k; a traveling crane or trolley hoist, K, with hand chains.

As is known, the 4-cycle Diesel motor must make 2 complete revolutions to produce one complete power stroke of the piston. The 2-cycle motor, which has one power stroke during each revolution, was developed for the purpose of obtaining a higher power for a given volume than is obtainable with the 4-cycle type, and thus reducing the unit cost of motive power installation.

For equal cylinder volume, the 2-cycle motor then develops about 60 per cent more power than is produced by the 4-cycle type. It is true that 2-cycle operation requires a special scavenging pump, serving to expel the gases of combustion from the cylinder, and that this is not required with the 4-cycle type of motor. Except under special circumstances, the 4-cycle type is to be recommended for installations of minor or medium size. In the case of large installations, however, the addition of the scavenging pump becomes of relatively small importance. Furthermore, the air for sweeping out the cylinders is furnished under very low pressure, so that this air pump works under most favorable conditions.

With motors of large size, the possibility of reducing the weight and cost takes precedence over other considerations, for the frames, the base plates, and the flywheels of large, 4-cycle motors are so heavy that their transportation and their erection impose difficulties. Furthermore, the 4-cycle engine is limited, as already suggested, by the heat and the inability to cool the cylinder, while in the 2-cycle this difficulty is overcome by the inrush of the scavenging air near the completion of the expansion stroke. This is why preference is given to the 2-cycle type in motors exceeding 700 hp.

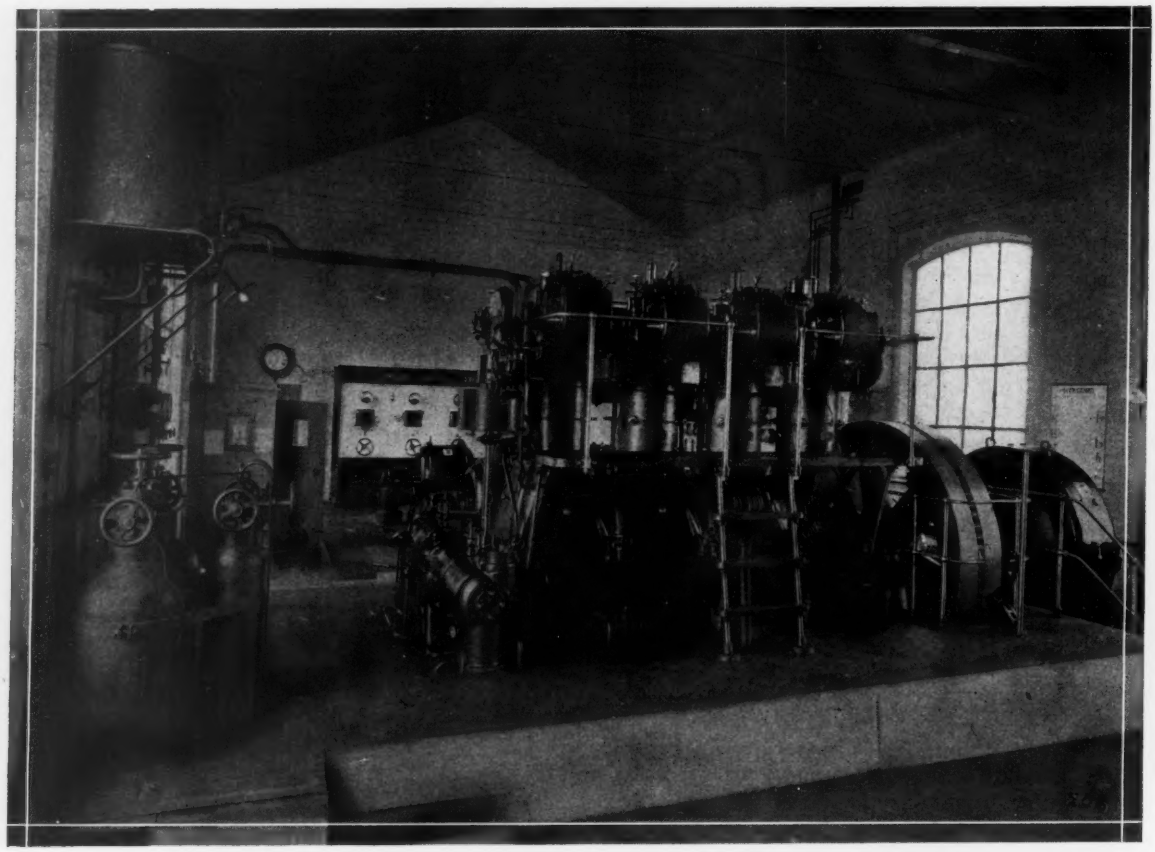


FIG. 3. INSTALLATION OF HIGH-SPEED DIESEL ENGINES AT LURATE-CACCIO, ITALY

The external aspect of both types is much the same, although the 2-cycle type gives almost double the power for the same cylinder volume, and in addition to the resultant decrease of weight and cost, takes up less space and materially reduces the total cost of installation. Furthermore, the 2-cycle system has the advantage that the revolving masses necessary to obtain a given degree of regularity may be much smaller, which is important, when this weight is to be incorporated in the rotor of an electric generator. The extra attendance imposed by the introduction of the air pump is compensated by the suppression of the scavenging valves.

Diesel motors of 2-cycle type are now built for powers between about 700 and 7000 hp., with 3, 4 or 6 cylinders,

according to size. The speed of the Diesel motor varies between 170 and 105 r.p.m. So-called high-speed machines are now on the market. They are generally built within the limits of 50 to 1000 hp., and their speed varies between 375 and 215 revolutions. The high-speed Diesel motor is the product of the demand for a motor which may be direct coupled to electric generators, centrifugal pumps and other driven machines, running at a higher speed than that heretofore realized with motors of ordinary type. These engines are generally built on the 4-cycle type, and are often installed as a reserve unit, as its price is relatively low and its space requirements, especially in height, are small.

The Diesel engine cannot yet be considered to have reached the limit of its developments or its usefulness. In fact, the various stages of improvements have been

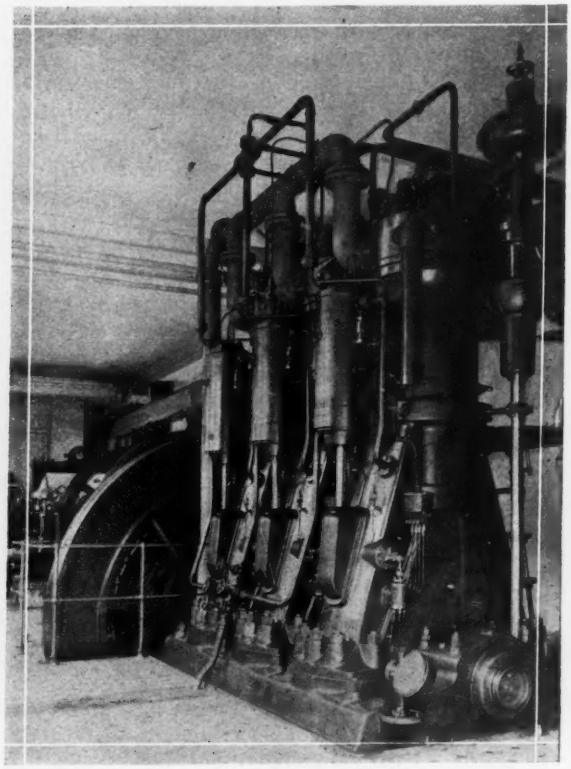


FIG. 4. ELECTRIC PLANT AT BERNE, SWITZERLAND, EQUIPPED WITH 4-CYCLE DIESEL ENGINES

gone through in a constant rush; many ways of applying the engine are still in store, awaiting the further improvements which will be made as a consequence of further development of science and the ability of engine builders.

The accompanying photographs should prove interesting as illustrating some typical stationary Diesel engine installations.

It must be stated that it is not claimed that the Diesel engine can be used with the fullest possible advantage in any and every case, and there are situations where steam plants must be preferred, such as in works situated in the heart of coal-bearing tracts, where the stations have an excellent load factor.

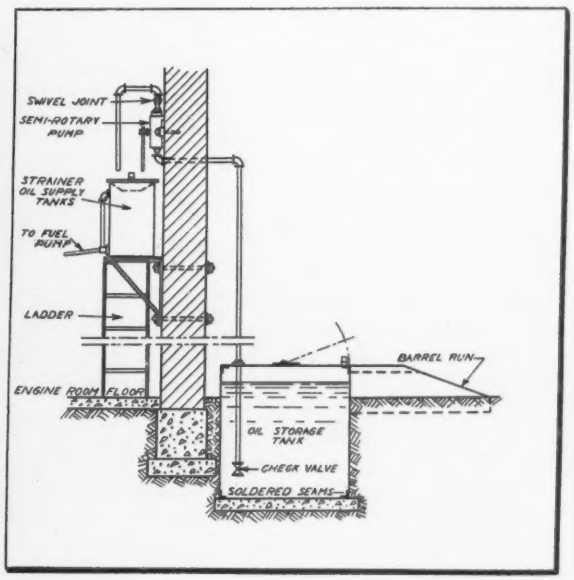
Operating Small Diesel Engines

By Wm. Scott

THE cheapest and heaviest crude fuel oils can be used in the Diesel engine; and while this advantage is a large factor in the commercial economy, the outstanding feature of this type of engine, is the high efficiency obtained by the excessive air compression.

At the end of the compression stroke, and just before the admission of the oil spray, the pressure in the cylinder is about 500 lb. per sq. in. The mixture of oil and air is ignited by the heat generated during this stroke, a radical departure from the usual methods, such as by an electric spark or hot tube.

High compression is obtained by the use of a very small piston clearance, and it is impossible to obtain these high pressures by barring round the engine, as in starting an oil engine of the usual type.



OIL RESERVOIR SYSTEM FOR DIESEL ENGINE PLANT

After the regulation of the oil supply, the Diesel engine is started as an air engine, by admitting compressed air from starting reservoir, containing a pressure of 600 lb. per sq. in., and when the engine has made a few strokes, the full supply is turned on, and the connection to the air reservoirs is closed, the engine then runs as an oil engine.

An air compressor, forming an integral part of the engine, is operated by the main shaft, and delivers air to a small receiving reservoir, which, in turn, delivers it to 2 large starting reservoirs, one of which is kept full as a standby.

It should be impressed upon the mind of the engine operator that carelessness in opening the valves of these starting reservoirs, during an attempt to start the engine, may result in the pressure dropping so low that the engine cannot be started. If this should occur, it would result in a temporary shutdown of the factory until cylinders of compressed air could be obtained.

Compressed oxygen must on no account be used, as a serious accident may result. If the size of the installation will warrant the expenditure, a small air compressor, driven by a gasoline engine, may be kept for this emergency and convenient connection from this to the reservoirs could be made. In small installations, one or 2 cylinders filled with compressed air might be kept in the storeroom ready for instant use. A careful test on the gages of all the reservoirs to see that they are full should be made part of the routine in shutting down the engine.

The fuel oil used in these engines is crude and unclean and should be mechanically filtered or trouble may be experienced with the spraying needle or the fuel pumps and pipes may clog. The supply tanks, from which the oil flows to the engine by gravity, as shown in sketch, have wire gage strainers, but it is necessary to pass some classes of oil through cloth or fiber filters to remove the finest particles of grit, etc. A convenient method of storing and handling the oil for a small plant is shown in sketch.

The valves should be inspected and changed at regular intervals, and a log sheet should be drawn up, to be signed in some plants by the superintendent to show that this has been done. The makers of the engine will suggest a schedule, but this will be modified after the effect on the engine of the fuel oil used has been noted. The valves taken out should at once be cleaned, ground and stored away ready for the next inspection.

Particular care should be exercised in tightening up the glands on the valves of the high-pressure side of the air compressor, as carelessness in this respect may result in breakage. Purchasers of engines are advised to see that these glands are made strong enough to withstand these strains.

The high temperatures in the engine and compressor cylinder call for careful inspection of the circulating water. Clogging of the passages by sand from dirty water may occur, lessening the flow of cooling water and possibly causing the pistons to "seize."

The Diesel engine is noted for its economy, simplicity of construction, and ease of operation; but sufficient has been said to show the necessity of care to prevent the worst misfortune that could happen to an operating engineer—namely, a complete shutdown.

International Engineering Congress

ATTENTION of the engineers of the world is being more and more drawn to the program of the International Engineering Congress, which is to be held in San Francisco, Calif., in 1915. The interest which has been aroused in foreign countries is shown by the fact that at the present time there have been received enrollments and subscriptions from 42 such countries. It is furthermore to be noted that, of the present total enrollment, approximately 25 per cent is from countries other than the United States. The number of subscriptions from the members of the 5 national engineering societies of the United States, under whose auspices and control the Congress is being held, is, however, not so gratifying. The percentage of the total membership of these 5 societies represented by the subscription list is only 3.7.

The list of topics to be treated in the Section on Mechanical Engineering gives a good idea of the character of the publications which it is intended to issue and the topics which will be presented and discussed at the meeting. These are as follows:

(1) Recent progress and present status of foundry practice, and casting metals.
(2) Recent progress and present status of the art of forging.
(3) Equipment processes, and methods for the boiler-shop.
(4) Machine-ship equipment, methods, and processes.
(5) Automatics.
(6) Special processes for shaping and forming metals.
(7) High temperature flames in metal-working.
(8) Industrial management.
(9) Safety engineering.
(10) Industrial museums as an educational factor.
(11) The steam-engine of the year 1915.
(12) The steam-turbine of the year 1915.
(13) The internal-combustion engine of the year 1915.
(14) Motors of the Diesel type.
(15) The Humphreys gas pump.
(16) The steam boiler of the year 1915.
(17) Refrigeration.
(18) Pneumatics.
(19) Lubrication and lubricants.
(20) Water wheels of pressure type.
(21) Water wheels of impulse type.
(22) Hydraulic power developments and use.
(23) Power plant design.
(24) Motor vehicles, passenger type.
(25) Motor vehicles, utility type.
(26) Motor tractors.

Many of these topics will be treated as symposiums with contributions representing the practice in more than one country.

The various sections outlined for the work of the Congress and the volumes to be issued are as follows:

Vol. I. The Panama Canal.
Vol. II. Waterways and Irrigation.
Vol. III. Municipal Engineering.
Vol. IV. Railways and Railway Engineering.
Vol. V. Materials of Engineering Construction.
Vol. VI. Mechanical Engineering.
Vol. VII. Electrical and Mechanical Engineering.
Vol. VIII. Mining Engineering and Metallurgy.
Vol. IX. Naval Architecture and Marine Engineering.
Vol. X. Military Engineering, and Miscellaneous.

It will be noted that the proceedings of the Section on Mechanical Engineering will be published in Vol. VI, with some of the papers falling into Vol. VII. It is also noted that Vol. X will consist only in part of Military Engineering and will also contain papers on miscellaneous topics which are not definitely associated with any of the various sections.

Full information concerning the Congress may be obtained by addressing the Committee on Management as follows: International Engineering Congress, 1915, Foxcroft Building, San Francisco, Calif.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Trouble With Compound Feeder

DISCUSSIONS IN recent issues of Practical Engineer, started by Mr. Packingham in the issue of Dec. 15, '13, lead me to relate my experience with a "barrel overflowing" in an instance similar to the one he relates.

In my own case, I had a pump connected to a well and to the city mains on the suction side. I had a boiler pressure of 125 lb., and a pressure on my city main line of 100 lb. In place of the ordinary foot valve, I had a standard vertical check valve. One day I noticed that my pump seemed to be failing to keep my boilers supplied with water, and could not understand, for some time, why that was.

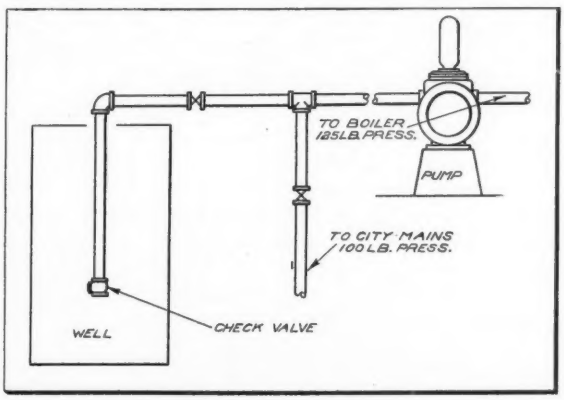


FIG. 1. SUCTION CONNECTIONS TO PUMP WHICH GAVE TROUBLE

The water pressure was very light in the mains this particular day, and the fireman, allowing the water in the well to get a little too warm, had opened the valve from the mains and had gone to do something else and forgotten it. One would naturally have thought that this would not have caused the pump to fail in taking water, yet the water in the well kept disappearing, and the boilers did not gain any from it.

Finally, I shut down the pump, closed all the valves, started the injectors, and took the valve chamber off the pump. I found my suction valves were leaking badly, one being held up by a chip, yet closing enough so that the pump did not jerk badly on that end. The other had a piece out of it. The check in the well was therefore acting as a suction valve, allowing the water to be drawn from the well, and then seating, while the boiler pressure on the one side held back the water, forcing it out into the mains which had but light pressure, as mentioned.

Shortly after this, a brother engineer called me in, telling me of a case similar to Mr. Packingham's, his being also a compound feeder causing trouble. He had a large funnel on the suction line from an open heater, the water from which flowed to his pump. By some chance idea, which he fondly hoped would prove to be an improvement, he had inserted a check valve between his pump and the heater, the feeder funnel being between the pump and the check valve.

This was his first experience with a compound, and he was just trying it out. But the pump, instead of drawing in the compound, even though he carried water lower in his heater than the funnel level, forced it out the funnel. Having recently had the experience with

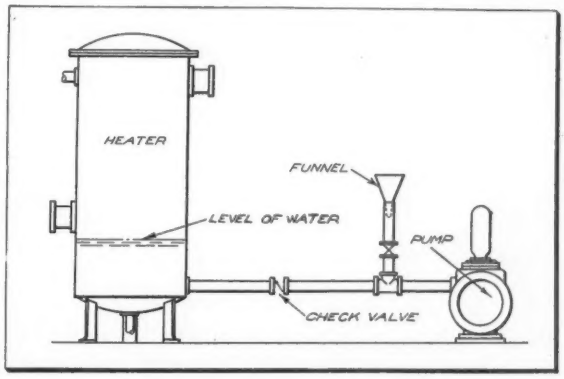


FIG. 2. COMPOUND FEEDING ARRANGEMENT

my own pump, I helped him replace, or rather turn over, his suction valves, which were scored badly, and he had no more trouble. I judge, therefore, that Mr. Packingham has a good foot valve on the end of his suction line, and that his suction valves leak some. JOHN PIERCE.

Stresses in Simple and Tandem-Compound Engines

MR. WALLACE, ON page 367, tells G. C. W. that it is possible, "with the assistance of the chemist," to determine the stress on pins, slides, etc.; but he does not tell how the maximum stresses compare in the ordinary running of the engines. It seems to me a mechanical engineer would be of more use than a chemist in designing the parts or calculating the stress.

If 2 engines of the same rated capacity and of the same stroke and speed are developing the same power, one simple and one tandem compound, in general the maximum stress in piston rod and the maximum pressure on crosshead pin and crankpin will be greater in the simple engine. The maximum pressure on the

guides depends somewhat on whether cutoff is early or late, but in general will be greater on the compound engine. The average pressure on both pins and guides will be the same in both engines.

Cutoff will be later in the compound, for there are nearly as many cubic inches of steam in the high-pressure cylinder at cutoff as in the simple cylinder at cutoff and the cylinder is much smaller in diameter, thus the pressure in the simple engine cylinder starts falling sooner and falls faster, so the average in the 2 engines is the same. The principal saving of a compound over a simple engine is in condensation, and this does not affect the number of cubic inches of steam in the cylinder at cutoff. Abnormal receiver pressure and other things affect the maximum stresses, but in general the above is true. HARRY D. EVERETT.

Controlling Temperature of Paper Mill

THIS IS an improved system recently patented by the writer which I think, from his letter in the March 15 issue, is what H. H. S. is looking for.

You will see the small circles, numbered 12, are dryers. No. 11 is an 8-in. steam line supplying dryers with exhaust steam. You will further notice that No. 1 is the return line, 6 or 8-in. All siphon pipes from dryers are connected with this line and are 1 in. in diameter. This line leads to controller tank No. 8, about equal parts of water and steam go into this large holder, where the steam is separated from the water.

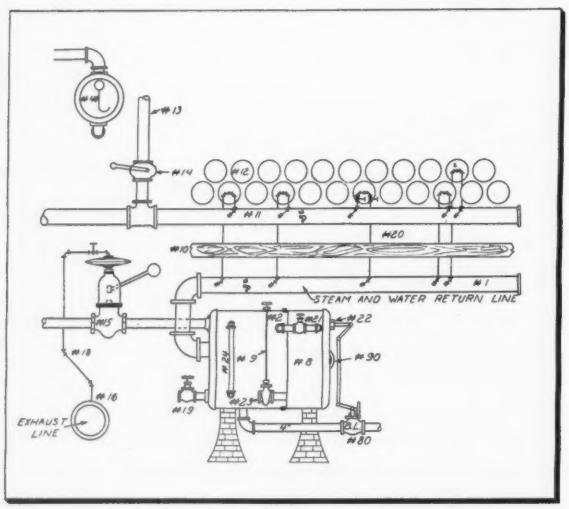


DIAGRAM OF PAPER MACHINE WATER CONTROLLING SYSTEM

Valve No. 15 is a valve for maintaining drop in pressure from the initial exhaust pressure; this valve will maintain a drop of 5 lb., which you will readily see will cause a high circulation in dryers, therefore bringing all the water from the dryers and delivering it to tank No. 8. The steam from this tank is used for heating feed water for boilers or goes to tank No. 40, which is a large tank holding water to be heated for header room. In this tank we have an 8-in. manifold header the full length of the tank, with 50 1-in. pipes bent as shown in the sketch, thus causing the water to rotate and heat rapidly to the desired temperature.

The large receiver tank, No. 8, has a compartment in it for the actuating float mechanism, which controls valve No. 80, that returns the water of condensation to boiler feed water well. This tank has a compartment, and the 4-in. valve, No. 23, which supplies water to the compartment where the float is, in case the float should go wrong, valve 23 can be shut, at the same time shutting No. 21, an equalizing line, and then by taking out manhole head, No. 90, the float can be repaired without any delay to the system, by blocking valve No. 80 open. This tank is under enough pressure to return all water of condensation to the heater.

We use no trap or pump with this system; in case pressure builds up, the atmospheric pressure valve, No. 14, opens at 16 or 17 lb. OTTO BAKER.

Success Due to Persistence

I ALWAYS read the correspondence of Sandy MacDougal, as there is invariably some good common sense interspersed, that many a young man could read with interest and profit by it, especially that portion relating to installment plan and money loan sharks that wreck so many homes.

Advice to select the work that is most congenial, then everlastingly stick to it, is also well timed, thus showing the employer that you are interested in the work set before you, even if the task is somewhat out of the beaten path, as nothing is more exasperating to the foreman or superintendent than to see a workman take hold of a job in a dissatisfied manner that speaks louder than words; that man is sure to be marked when the time comes to reduce the force, and he evidently is one of those who is continually going from one job to another in search of that better chance.

The writer is well acquainted with a workman who can verify many of MacDougal's remarks, as he has been through the mill from machine shop to journeyman—getting married—foreman and general superintendent. This young man soon found out that if he wanted to earn more he must know more, also that no union could furnish brains or ambition to forge ahead, hence it was up to him to make good or plod in the same old rut.

He accomplished his purpose through various processes, such as subscribing to practical magazines devoted to matters connected with his line of work, also night schools and a diligent and persistent study at all leisure hours, and while many of his coworkers were discussing matters that benefited nobody, such as the last baseball game or politics, at some cigar store or rum hole, he was either at school or studying at home or working overtime; he never worked less than 10 hr. a day or 60 hr. a week, and some years made more days of 10 hr. each (by overtime) than there were days in the year.

He was also strictly opposed to going in debt for personal property of any kind, hence it was frequently a case of self denial, and especially so after he was married; no matter how badly they needed articles of cloth-

ing, furniture or extra groceries, they got only such as they had the cash to pay for, no installment or grocery collector ever came to their door. In order, however, to do this and be independent, he denied himself many selfish enjoyments, such as baseball and football games that would not only mean a half or whole day's work, but car fares, entrance fee, etc., and whenever he felt he could afford some enjoyment, it was of such a character that the whole family of four could enjoy. This persistent method of economy for some years (he saw early in life) was the only safe plan to adopt in order to acquire a fair competence for his declining years. He changed positions only 4 times in over 40 yr., and every change was an advance. The above is not cited as an exceptional case, as the same can be accomplished by any progressive and energetic young man by reason of shorter hours and better equipped libraries than there were 30 and 40 yr. ago. OLD MACHINIST.

Proper Location for Fusible Plugs

IN THE March 15 issue, in an article on fusible plugs, mention is made of the location in water-tube boilers with horizontal or inclined drums.

In 2 states—namely, Massachusetts and Ohio—the exact location of the fusible plugs in the different types of boilers is fixed by law and for water-tube boilers as follows:

Babcock & Wilcox type—in the upper drum, not less than 6 in. above the bottom of the drum over the first pass.

Stirling boilers, standard type—in the front side of the middle drum, not less than 4 in. above the bottom of the drum.

Stirling boilers, superheater type—in the front drum, not less than 6 in. above the bottom of the drum.

Heine type—in the front course of the drum, not less than 6 in. above the bottom of the drum.

Worthington type—in the front side of the steam and water drum not less than 4 in. above the bottom of the drum.

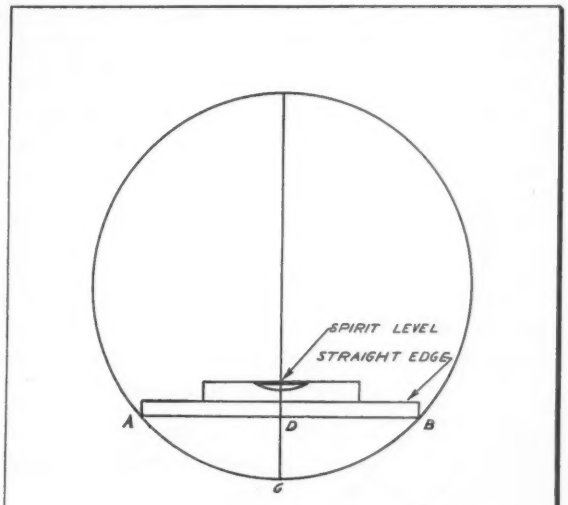
In all cases, the plug must project through the sheet not less than 1 in.

These locations have come to be regarded as standard in many cities where fusible plugs, even though not required by law, are considered desirable, and to assist the engineer and boiler inspector to determine quickly and accurately the point at which the plug should be placed, the table and sketch are given.

A section through a drum is represented in the sketch, C D representing the height of fusible plug measured along the vertical diameter of the drum. The chord A B passes through point D and is perpendicular to C D.

To utilize the table, the diameter of the drum is measured and the height at which the plug should be is determined from the rules previously stated. These 2 factors being settled, we refer to table and find the corresponding length for A B. A straight edge of the required length is then cut and laid across the drum, as shown and made level by means of a spirit level. The points at which the straight edge touches the drum will then be at the correct height for fusible plug. Which point to use is, of course, determined by the rules in boilers of the Stirling or Worthington types. In the other types of water tubes, either side of the drum will answer; but it is always well to try to place the plug so that it will be visible through a clean-out door or other opening in the side of the setting. The length of the arc A C would be used by the layer out working on the flat sheet.

Engineers sometimes object to fusible plugs, for the reason that the metal has been known to melt when there were several inches of water above the plug. This



DIAM. INCHES.	CD INCHES.	AB INCHES.	ARC AC INCHES.
30	4	20.4	11.2
36	4	22.6	12.2
42	4	24.6	13.1
48	4	26.6	14.1
30	6	24.0	13.9
36	6	26.8	15.1
42	6	29.4	16.2
48	6	31.8	17.4

METHOD OF MEASURING BOILER FOR INSTALLING FUSIBLE PLUG

may have occurred with a short plug that just came through the sheet, but a long plug filled with pure tin and the large end of the soft metal to the pressure is generally good for a couple of years' service and often longer before it begins to disintegrate. Of course, if the plug is allowed to become heavily scaled or covered with grease, it may blow out with plenty of water above it. This, however, is in favor of the plug as a safety device, since such a boiler would undoubtedly be in need of attention. E. R. DOHERTY.

Balancing A Steam Turbine

IT MAY be of interest to some engineers to know how "knocks" in steam turbines are sometimes eliminated.

A large horizontal steam turbine was being installed in one of the large central stations in the East. It was hoisted onto a high pedestal that had been designed and built with no little difficulty, and the engineers were anxious to have a turbine on its top that would be as free from vibration as possible.

Steam connections were made and the turbine was then tried out, but it was evident from the start that the rotor was distinctly out of balance, for the pedestal, turbine and everything vibrated furiously, even before normal speed was reached.

One unacquainted with steam turbine practice would doubtless think the righting of this unbalanced rotor to be a most complex problem. That's what I thought until I saw the expert at work making things as they should be.

In the coupling between the turbine and generator were about 24 plugs set concentrically about the shaft, screwed into the coupling flange. Each plug weighed, perhaps, 2 lb.

He removed one of these plugs, turned on the steam, and noticed that the vibration was even worse than before; so he replaced the plug and took out a plug diametrically opposite. On starting the turbine again he found the vibration to be considerably lessened. Then he took out a plug that was set at 90 deg. with the first diameter, tried the speed again, and so on until the powerful machine ran without a quiver. The solution, you see, was nothing more or less than a cut-and-try method that almost any mechanic would be willing to tackle after seeing once how it was done.

Of course, in this instance the expert was not only a "balancing expert"; he knew the turbine from A to Z, installed it, balanced it, and put it in proper condition all around for continuous year-in-year-out service.

N. G. NEAR.

Brine Tank Temperature

IN LOOKING over the April 1 issue, I note what W. S. says about preserving the temperature in his brine tank. If the end of the discharge pipe from the brine cooler is below the surface of the brine in the freezing tank, there will be quite a rapid circulation with the brine pump stopped when valves A and B are open, but not unless the discharge is submerged. The reason for this is, that there is a difference of specific gravity in the brine in the bottom and top of the tank, due to its difference in temperature. If this line is covered, as it should be, there will be some benefit derived by keeping the brine in circulation.

A certain small plant with which the writer is familiar is, as a rule, operated about 10 to 16 hr. a day to keep up the supply of ice used in the building. The brine circulating pump is connected as shown in the sketch of W. S., except that the expansion coils are in the brine tank, and the brine pump on the same floor as the tank with the discharge pipe not submerged. When the plant was first started, it was customary to stop the brine pump when the compressor was stopped, and a difference in temperature of several degrees was noted in the brine in different parts of the tank after being shut down a few hours. From the records kept of the ice pulled, and hours that the plant was run each day, it was found that ice was being made during the 24 hr. at the rate of 100 lb. for each 36 min. that the compressor was operated, the plant being rated at 4 tons of refrigerating capacity or 2 tons of ice per 24 hr.

This was figured out by dividing the time in minutes that the machine was in operation by the number of hundredweight of ice pulled, which, if taken over a period of several days, and at a usual rate of ice pulled, is fairly accurate. In this case, about the same amount was pulled each day with a gradual increase during the hot months.

It was then decided to run the brine pump continuously, whether the compressor was in operation or not. After a few days, it was found that the plant would make ice at the rate of 100 lb. per 24 hr. for every 28 min. that the compressor was in operation, with the temperature of the water for the condenser and cans (this is a raw-water plant) remaining the same in each case. The circulating pipe was, of course, insulated. This showed a material gain, as it was not necessary to run the compressor so many hours a day as it was with the brine pump stopped. The reason for this saving was, that with no circulation in the tank, the brine near the cans became warmed by the transfer of heat from the cans, and, as the difference in temperature became less, a slower transfer of heat took place than when the brine was in constant circulation, which brought the cooler brine in contact with the cans at all times.

In making this investigation, however, it was found that with the brine pump stopped when the compressor was stopped, the average temperature of the brine in the tank was lower on starting up than when the pump was left running; this, with the increased output of ice per hour of operation, showed that when the brine was not being circulated it was not absorbing heat from the water in the cans as fast as it should, and that with a given brine temperature when the machine was stopped, the warmer the brine was the next time the machine was started, the more ice it made during this idle period, unless the temperature went above 30 deg.

W. S. states that he found the brine about 10 deg. lower when the brine was not circulating. If the pipes are not covered, there will be considerable loss from radiation from the pipe; but part of the difference in temperature is due to the increased efficiency of the brine to absorb heat from the cans when in circulation, and very likely a greater amount of ice would be made during the hours that the machine was stopped. It would require a longer time for the compressor to bring the temperature of the brine down to a given degree with the circulation left on; but there is much room for argument as to whether it would increase the average length of time required to freeze a given amount of ice per day, which would be the proper way of determining whether it was best to run the pump or not, while the machine was shut down. It is possible that the gain from keeping the brine in circulation would be greater than the loss from the brine's absorbing heat from the atmosphere.

J. C. HAWKINS.

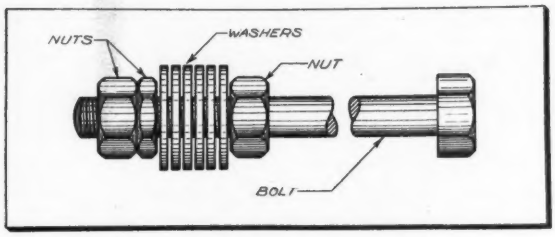
Successful Kinks From The Plant

For Saving Time, Work and Trouble

Dressing Emery Wheels

THE SKETCH shows a cheap and efficient emery wheel dresser that I have been using with great success. By the use of this arrangement one can keep the emery wheel in fine shape at no cost whatever. One set of washers will almost outlast the best kind of grinder (or dresser). Almost every shop can pick up a few washers that have been thrown to one side.

This dresser is simple in construction, and can be made in a few minutes. All that is required is a half dozen iron washers, a bolt with 2 or 3 in. of threads and 3 nuts. Take a bolt on which the washers will fit loosely,



EMERY WHEEL DRESSER

say a 5/8-in. bolt and 6 5/8-in. washers, run the first nut on until it can be drawn up tight against the unthreaded part of the bolt, then put the washers on and run the second nut up within 1/16 in. of the washers; lock this one with a lock nut and the job is completed.

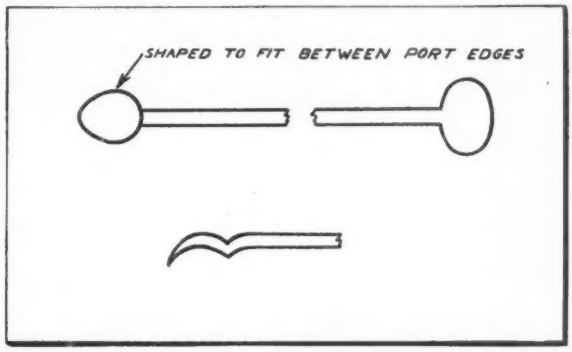
When the wheel gets a little untrue and rough, hold the dresser firmly against the surface to be dressed for a few turns and you have a wheel that is in good shape.

J. B. LINKER.

Lubricating Difficulties Overcome

SOME TIME ago, I had trouble with the dashpots on my engine sticking up; that is, they would not go down as far as they should when the air valves had to be adjusted again. This was the case especially when the steam pressure was high. At first, I thought that the oil I was using at that time was the cause, as I had made a change in cylinder oil; but in examining the valves, I found that the edges on them were very sharp, due to wear; the edges on the ports were in the same condition, and it was my belief that this was the cause of the trouble. The sharp edges were removed with a file. To remove the sharp edge on the ports I used a tool, as shown in the illustration, on which the cutting edges were shaped to fit between the 2 port edges, which did the work fine. After this, there was no more trouble with the dashpots sticking, which showed that these sharp edges would scrape the oil from the working parts of the valves and ports.

A single double-acting boiler feed pump made a groaning noise in the steam cylinder, when the feed valve on the lubricator was nearly wide open the noise would stop. When the steam cylinder was examined it was found lack of oil was the cause and it was thought that the oil used was not suitable. Another oil was tried, but the same trouble existed. When the feed valve on the lubricator was wide open, the noise would stop, so some more examining was done on the steam end. It was found that the drain valve, which is located above



SCRAPER FOR STEAM PORTS

the steam valve in the steam pipe, leaked badly. The cause of the trouble was found, as most of the oil went direct into the drain pipe, then into the sewer, while the steam cylinder got little of it except when the lubricator was feeding very fast. When the drain valve was made tight, there was no more noise, the opening of the drain pipe was in line with opening of lubricator connection, and I believe this was the reason more oil went in the drain pipe than into the steam cylinder.

H. JAHNKE.

Smokeless Combustion of Oil

SMOKELESS economical combustion of fuel oil under return-tubular boilers is easily accomplished by admitting the necessary air through a bed of crushed firebrick spread over the grate, same as you would coal. Use no fire clay; if the flame strikes the boiler too hard in the center cover the grate under that place with asbestos mud, also all grate surface your burner can not reach, then cover with crushed brick. All air must be admitted under the fire, broken up and heated on the jagged edges of firebrick before it reaches the fire. Burn nothing but oil to keep ashes out. JOHN KROPP.

IF YOUR SPARK PLUGS are dirty and bother by misfiring, try boiling them for a couple of hours in a solution of washing soda, a teaspoonful to a quart of water; then watch the result.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Belt Transmission Problems

How do you set the pulleys for a ⅛-twist, ¼-twist and ¾-twist belt?

I understand that for setting pulleys for a ¼-twist belt that you should drop a plumber line from the center of the slack side of the driver to the center of the tight side of the driven. The belt runs just the opposite. Is this correct? E. A. G.

A. The general rule in regard to pulleys otherwise than parallel, is that the belt must lead onto each pulley along its center line. It may leave the pulleys in almost any direction. If it does not lead onto the pulley straight along the center line, it will run off to one side and drop off the pulley; but as long as it leads on correctly, the pull on the leaving side will not throw the belt off.

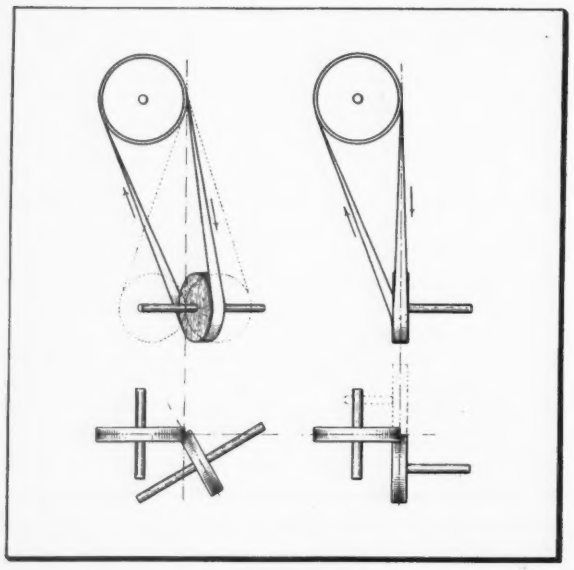


FIG. 1. EIGHTH AND QUARTER-TURN BELT ARRANGEMENT

There is a full explanation of the methods of setting different twists, in the January, 1911, issue of Practical Engineer, pages 22 and 23.

One-eighth and ¼ are comparatively simple. The ¾-twist is a difficult one to set, and will usually require the use of 2 guide pulleys to get a satisfactory result.

The enclosed sketch will show the principle for the ⅛ and ¼ turn, and the use of guide pulleys. The same principles apply for any other angle. A. L. R.

Cylinder Oil Specifications

WHAT IS the proper cylinder oil to be used on a Brown engine 20 by 48 in., steam pressure 100 lb., 87 r.p.m., load 200 hp., the steam containing considerable moisture? G. W.

A. The following specifications will prove satisfactory, under the foregoing conditions:

Cylinder oil: This oil shall consist of a high-grade mineral cylinder stock (filtered or steam refined), compounded with 5 per cent by volume of pure acidless tallow oil.

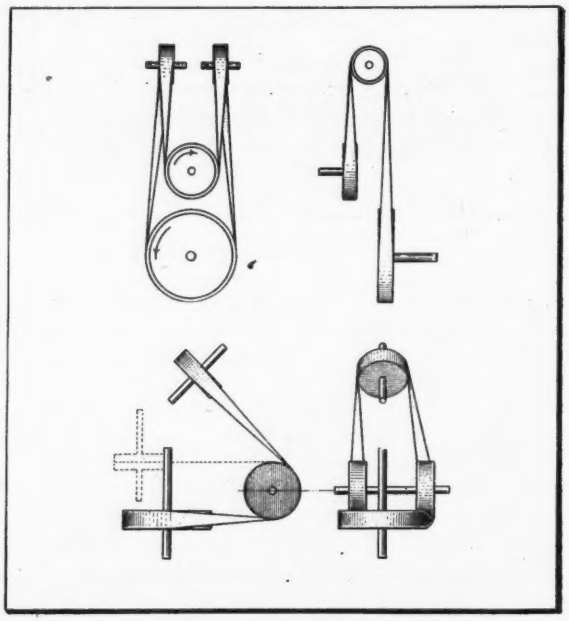


FIG. 2. USES OF GUIDE PULLEYS

The mineral cylinder stock used for compounding the cylinder oil shall have the following characteristics:

MINERAL CYLINDER STOCK

Gravity	24 to 27 deg. Baume
Cold test	30 to 35 deg. F.
Flash	550 deg. F.
Fire	560 to 600 deg. F.
Viscosity	160 to 180 Saybolt universal viscosimeter
Color	Reddish brown or green

A mixture of 5 per cent by volume of the cylinder stock with 95 per cent by volume of 88 deg. Baume gasoline should not show a precipitate of tar or suspended matter on standing for 15 min.

The tallow oil increases the ability of the mineral oil to stick on the moist cylinder walls. In practice, it may be found possible to reduce the amount of tallow oil to 2 per cent (which would be good practice); under bad conditions, the amount of tallow oil can be increased up to 10 per cent, but it should not be necessary under the conditions given above. A lower gravity mineral cylinder stock can be used if higher gravity cannot be obtained; the other characteristics remain the same.

PHILIP A. MOORE.

Ash Gun

PLEASE INFORM me how to construct a hydraulic ashblowing device such as they use on lake steamers. We have 3 Stirling boilers, 250-hp. each, and would like to blow the ashes out, as I think it would cut down expenses over wheeling them out.

About 150 ft. from the boiler room is a lake, 25 ft. lower than the boiler-room floor; it would give me a good chance to lay the pipe underground, and as the lake is 30 ft. deep where I intend to blow the ashes, it would give me plenty of room. How large would the overflow pipe have to be, and how much would I have to reduce the discharge pipe from the pump into the hopper where the ashes are thrown? Our discharge on the pump is 4 in. C. L.

A. The American Ship Building Co., of Cleveland, makes these ash guns. There is nothing intricate about them, or nothing that anyone has a patent on that we know of. The device consists of a cast-iron hopper or bowl, with a cover on hinges, which can be fastened down in stormy weather by means of clamps which engage in lugs on the cover. In the bottom of the hopper and pointed in the direction of the discharge over the side of the ship, which is generally a 7 or 8-in. steel pipe, is a tapered nozzle, the large end attached to a pipe connected to one of the pumps in the ship, whereby a pressure is obtained, and the water discharged through the small end of the nozzle, which is generally reduced to about ½ in. in diameter. The water issuing from this nozzle under pressure from the pump has a great force to it, and discharging in the center of the 7-in. pipe, described above, creates a sort of vacuum which takes the ashes along with the water, when they are shoveled in the hopper by the fireman, and discharges them over the side. R. L. PECK.

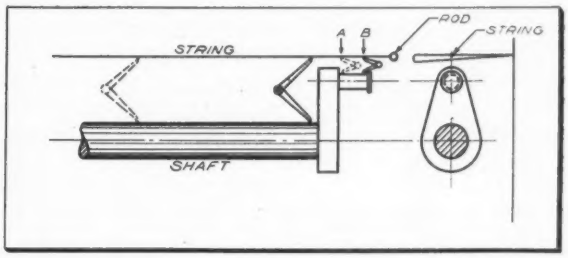
Lining An Engine

HOW CAN I tell whether the shaft is at right angles with the cylinder center line?

2. Explain a method of checking alinement of shaft and crankpin.

A. There are several ways in which the alinement of the shaft and cylinder may be checked. Nearly all modern engines have "spots" planed on the inside of the frame opposite the crank, and parallel to the center line of the cylinder. When this is the case, it is only necessary to caliper between one "spot" and a point on the crank disk or end of the crankpin as most convenient, then turn the crank over until the same point on the crank or pin comes opposite the other "spot" on the frame, and caliper here. If the shaft is in line or square with the cylinder, the 2 measurements will be the same. If not, one end of the shaft must be moved to bring them equal.

If no "spots" are planed on the frame, the shaft may be alined in the following manner: Take off the cylinder head, and bolt a strip of wood to one of the studs so that the end will extend out past the cylinder, and about as high as the center of the cylinder. From this stretch a fine line or wire to a support beyond the crank shaft. This may be a post fastened to the floor, or a piece of wood fastened to the wall at the same height as the center of the cylinder. Now measure the distance from the center of the counter-bore to the line at the end outside the cylinder, then lay off the same distance from the center of the piston rod and move the line up to it, then draw the line taut and fasten. This will make the line parallel to the center line of the cylinder. Then stretch a second line parallel to the center line of the shaft and at the same height as the center, fastening it to supports as before. Square this line with the line first set, which may be done with a



CHECKING ALINEMENT OF SHAFT AND CRANKPIN

square or by the proportions 3, 4, 5. The latter is the best method, and is done as follows: Measure off 3 ft. on one line from where the 2 lines cross and tie a string on the line here. Then lay off 4 ft. on the other line and tie a string here when the two lines are at right angles to each other the diagonal distance from one string to the other will be 5 ft. After the line is set correctly, measure the distance from the center of the crank shaft to the line on each end, and adjust the shaft accordingly. The accuracy of this method will depend on the accuracy of your measurements. If the piston, piston rod, and crosshead have been removed, the line can be run through the cylinder.

2. Fasten a strong string, or fine wire, to a strong rod, and place this rod near the crankpin, as shown in the sketch, so that the distance from the pin to string can be conveniently calipered. Fasten the other end of the string to another rod, or convenient post, so that the string is parallel to the engine room floor, and approximately parallel to the shaft.

Now caliper distance at A and B, changing the outer position of the string until the distances A and B are the same. The string is now parallel to the crankpin. Then measure the distance from the string to each end of the shaft, at points equally distant from the floor. If these measurements are alike, the shaft is in a plane parallel to the crankpin. Turn the crank about 90 deg. and caliper again to the crankpin, and if the ends are still equally distant from the string, the alinement is correct.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Ventilating A School Building

I HAVE charge of the heating and ventilating of a large high school in the West. My plant consists of 2 Bros return-tubular boilers, rated 175 hp. each; 2 York vertical 18 by 12 single engines, driving 2 8-ft. Sirocco fans; 1 7-hp. DeLaval turbine, for washing air; a Johnson control system, with double units for feed, vacuum, and air pumps, burning fuel oil.

I would like to ask a question in reference to ventilation. I have my own theory practically demonstrated, but would like to hear some expert's opinion on the subject. As we all know, the inlets to the rooms are some what larger than the outlets, and in this case the air delivered is 2070 cu. ft., measured by the anemometer. The outlet is 560 cu. ft., by the same method of measuring. Formula used, area in sq. ft. times velocity divided by number of pupils equals air delivered per pupil. Approximately ⅓ goes out of the outlet, and allowing leakage through doors and windows, considerably more, indicating the pressure in the rooms comes from a source of retardation when passing to the atmosphere from the attic through the roof.

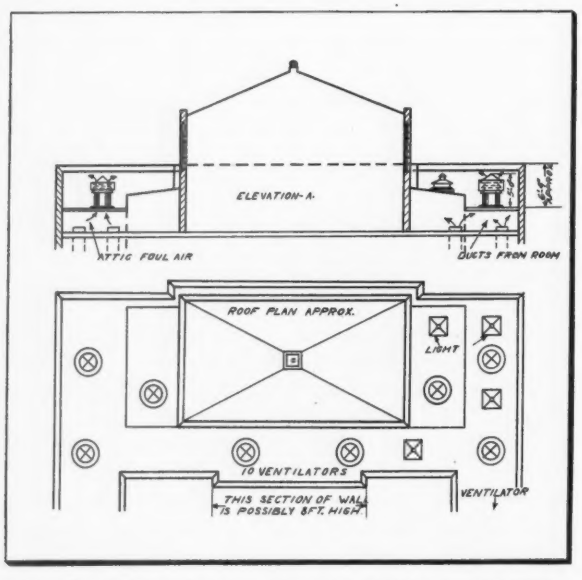


FIG. 1. ELEVATION AND PLAN OF SCHOOL VETILATING SYSTEM SHOWING LOCATION OF VENTILATORS

The ventilators in the roof are ample and large enough, but my contention is that these ventilators, being lower down than the fire wall which extends around the roof, are the cause, as it is 6 ft. 4 in. and the ventilators 5 ft. over all (see sketch).

I have noticed that at times there are currents of air which eddy inside the walls, causing a downward draft on the ventilators. This causes more back pressure on the foul air escapes, causing stagnation of air before it can escape from the rooms. I notice this from the fact that one section of the building occasionally reports stuffy air, another day another section, caused by the wind.

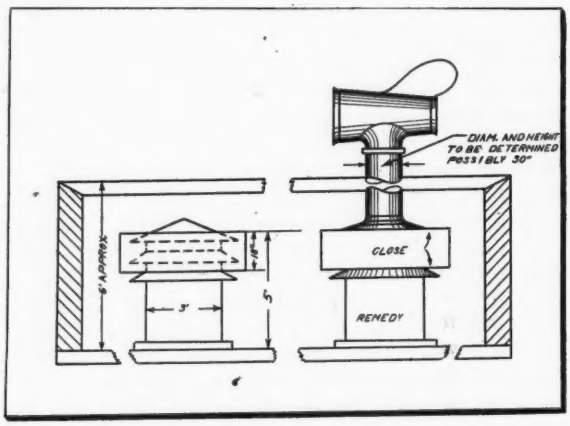


FIG. 2. ELEVATION OF PRESENT VENTILATOR AND PROPOSED REMEDY FOR DIFFICULTIES

Now my idea for a remedy is to extend the ventilators above the fire wall with a turning cowl that it may act as a siphon in expelling the foul air quicker. What would you consider the proper amount of air to be exhausted in the case mentioned? JOSEPH WEBSTER.

Question for Readers

WE HAVE a horizontal condensing steam engine, 24 by 60 in., running at 60 r.p.m., with boiler pressure 60 lb. On several occasions, water has been drawn up from the condenser, flooding the cylinder, lifting the inlet valves from their seats and damaging them.

What size relief valves should be fitted to the cylinder covers, and what pressure of loading would be suitable to avoid recurrence of the difficulty? The engine is of the 4-valve type, with flat gridiron valves.

I. X.

Boiler Furnace for Sawdust

WILL SOME of the readers give me a sketch of the best setting for 72-in. by 18-ft. return-tubular boilers, of 2 in a battery, of the Dutch-oven type, firing with sawdust and shavings, self-feed; A, with induced draft; B, with natural draft?

I am troubled with cinders coming from the smokestack, with natural draft, flying all over the yards, and combustion chamber filling up with ash.

Please give full direction of setting.

1. Which is the better, 1 or 2 feed holes in the top of a Dutch-oven furnace?

2. How can you tell whether you have good combustion by looking in the combustion chamber door?

3. Does sawdust make a long or a short flame?

4. Is it better to have all the draft come in below the grates, or some enter at top of fire, burning sawdust?

A. L. M.

Submerged Water Main

IF THE weather is severe, the proposed undertaking should be deferred until summer, to take advantage of the better weather conditions for the masonry work, and eliminate the disadvantage of having so much surplus water to contend with.

The first procedure in an undertaking of this character is to ascertain whether the stream is calm or violent at the point where the proposed line is to be constructed. Then, a method of making a temporary dam for a part or half of the width of the stream, should be decided on. This can be done easily by procuring a sufficient number of heavy bags, filling them full of sand and laying them in single or double file to the proper height of the proposed dam.

It would be well to provide a siphon or a large hand-pump to remove the water, or bail it out with buckets.

An improvised derrick can easily be rigged up by the use of a few forgings and a few pieces of 6 by 6 timbers, which will lighten the labor of handling the pipe. If rock or stone is plentiful, the bed of the stream can be dug out and a foundation made of stone, and after the pipe line is completed, a supply of stone can be laid on the downstream side of the pipe, which will act as a brace or anchor.

If the pipe is to be laid above the bottom of the stream it will be necessary to build suitable supports for the pipe. The best joint is the calked lead joint and is made as follows: Force a ring of hemp into the joint, and then set it with a calking tool until hard. After the hemp is firmly calked, an asbestos joint runner is placed around the top of the joint, leaving a small opening at the top for pouring the molten lead. The lead is then poured, and after cooling, firmly set down with a calking tool, care being taken to calk the inner and outside edges of the lead circle thoroughly. Each joint of 4-in. pipe requires approximately ¼ lb. of hemp and 7½ lb. of lead per joint, while 6-in. pipe requires ⅓ lb. hemp and 10¼ lb. of lead.

ROBT. P. HARRIS.

Drain for Steam Pipe

H. H. S., IN the March 15 issue, shows a sketch of a steam-heating connection to his paper driers, and wishes to know how to drain the condensate away from it. To my mind, the best way would be by a trap or pump, which he says the company will not get. A 1-in. drain pipe should be tapped into the bottom of the ell below the riser, to take care of the condensation between the riser, and also in the riser. This would also drain the 8-in. main to which the branches are connected if it pitches back toward the riser. If it pitches toward the end, or is level, there should be a 1-in. drain pipe connected to the bottom of the ell at the end. These 2 pipes may be connected together, and then to a trap.

If he cannot get a trap, put a valve on the end of the drain line, leaving it partly open to sewer or feed-water heater. This water should go to the feed-water heater after it has passed through an oil separator as it is hot.

He also states another serious fault in the system, and that is that the steam main is not covered. The main steam line from the engine to the mill is 120 ft. long, besides the long 8-in. header at the mill. If heat is needed for the mill in winter, this may be all right; but the cost of the amount of steam lost through condensation in this long, uncovered line would pay for the necessary pipe covering and steam traps in a short time, and if it was covered, there would be only a small part of the condensation to go through the heaters, as there is at the present time. In refusing to purchase a suitable trap and the necessary pipe covering for this purpose, the company is losing money in several ways. First, by not properly heating the rolls; second, by running serious chances of water hammer bursting the pipe or fittings; third, by wasting this hot water after it passes through the rolls; fourth, a large percentage of the exhaust steam leaving the engine is condensed before it gets to the rolls; fifth, the mill is kept uncomfortably hot by the radiation from this bare pipe, and many more of less importance could be mentioned.

It seems to me that, if the engineer put the case up to the company in the proper light, giving them a rough estimate of the saving in coal that could be made, he could get the traps and covering necessary to put the system in good condition. This proposition looks to me like one of the rare chances where the engineer can make a big saving in the cost of operation, which might bring an increase in salary if pushed along. If the company will not buy asbestos or magnesia covering, I would suggest that the line be covered with a box packed with sawdust, and covered on the outside with tar paper; this will help some. There are also several other home-made coverings that would cost little, and save much of the steam that is now going to waste. J. C. HAWKINS.

THE UNIVERSITY OF ILLINOIS has just concluded the series of tests which have been in progress at their Locomotive Testing Laboratory on the Illinois Central consolidation type freight locomotive No. 958.

This engine was furnished by the I. C. R. R. for the purpose of these tests and was placed in the laboratory about a year ago. Since that time many tests have been made by both the faculty of the College of Engineering and students in the Railway Courses.

The highest speed at which any tests were made was 45 miles per hour. The greatest tractive effort registered was 30,000 lb., while the highest horsepower developed was 1650.

The tests were conducted primarily to increase the efficiency of the locomotive performance. Considerable work was also done during their progress to improve the running of the locomotive. The data secured is now being worked up by the members of the Railway Department and the results of the tests will soon be known.

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Reclaiming the Barren Land

Through a large section of the country to the east of the Rocky Mountains, the great problem, in order to make the land productive, is the securing of water for irrigation. Near the mountains, where storage reservoirs can be planned, from which the water can be conducted to the surrounding plains, the problem is comparatively simple, although involving large expenditure. For a great section of country, however, the distance from mountain reservoirs is too great to permit of this method of irrigation, and recourse must be had to the ground water, which may be brought up from lower levels to give fertility to the surface soil.

Progress has been made in the pumping of water by plants located in the arid regions, and investigations have been made by the United States Geological Survey to determine to what extent this method is practical. The ground water supply is found largely in beds of sand and gravel, below the surface, and comes from the local rainfall, which is not inexhaustible, but which can be drawn upon for a moderate supply for irrigation purposes during the comparatively short season when it is needed. Pumping can be done at comparatively low cost, and if the water so pumped is carefully conserved and intelligently used, will generally be sufficient for the purpose. It is found that these sands and gravels lie near the surface over an area of more than 100,000 sq. mi. of valley and plain, in Eastern Colorado, New Mexico, Western Nebraska, Kansas, Oklahoma and Texas; that these beds will not, as a rule, produce flowing wells, but that the water must be secured by pumping, as has been successfully done in a number of places. The method is, however, applicable to a great area, and by the use of economical pumping machinery, water within 25 or even 50 ft. of the surface can be pumped to a profit, the lesser distance being available for general crops, and the greater for vegetables and fruit, where the returns per acre are greater and warrant more expense in the production. The water must, however, be drawn practically from the area where it is used, as the supply does not come from the mountains, but from the rain and snow that falls on the great plains throughout the year and percolates to the ground water level. This means the establishment of a large number of pumping plants distributed over the area to be served, and, therefore, offers a large field for the establishment of numerous small power plants, probably in most cases driven by internal combustion engines of some sort. It is a new application of power to the conservation and utilization of our natural resources and one in which a considerable development should be made in the near future.

A Profitable Department

Sometimes, or even more frequently than that, the opinion is ventured, in conversation or discussion, that Government departments and bureaus are rest cures for chronically tired political satellites. But facts to support such assertions are conspicuously omitted. From the officials of the Agricultural Department we have often heard that the greatest problem they have is to get the methods that have been proved successful, adopted into practice by those farmers who need them, and this in spite of the testimony of users of these methods as to the help and benefit derived from the Department and its information. In the reports are to be found a storehouse of knowledge, so complete that men who have come from cities with no experience whatever in farm work have been able to make successes from the start, often showing the way of advance in methods to those longer in the field.

The farmer has come, quite unjustly, to stand as a symbol for lack of progressiveness. But are those in other lines of work in any better condition? There are exceptions always who are awake, moving forward and standing out as big successes, but, on the average, are manufacturers, merchants and miners taking advantage of the service that Uncle Sam offers them in investigations and publication of results?

For instance, the report of the Director of the Bureau of Mines, just received, lists a series of tests and examinations on safety in mines, rescue work, treatment of ores and minerals, wastes in mining, uses of special minerals, investigations of values of fuels and the profitable use of low grades, the detail index occupying 6 pages, and the entire report, 118 pages. And this report gives only an outline of the work done; the records of the work may be illustrated by Bulletin 58 on Fuel-Briquetting Investigations, 277 pages giving complete records of tests of briquets and summary of results. This report covers the conditions of the industry, causes of failures, results in other countries, machines and processes used, costs, qualities of briquets and comparison of their convenience and economy with the original fuel, binders, and tests of coals and lignites from all parts of the country. The advantages stated may be briefly summarized as: Even size, do not cake, burn to fine ash without clinkering, less care of fire needed, greater evaporation, resistance to weathering, quick steaming, high rate of combustion, low loss from breakage, no spontaneous combustion. Cost of briquetting is figured at $1.062 a ton, to which must be added the cost of fuel for a ton of briquets, which will be that in the finished product plus that burned for power and drying. For lignites, 2 tons are used for a ton of briquets; for anthracite 1¼ tons; for sub-bituminous 1½ tons.

This is only one line of investigation that has been carried out by the Bureau of Mines, over a period of 8 yr., but it is safe to say that, if the information gathered into usable form were put to the greatest possible practical use, it would go far to make a saving far above the cost of the Bureau.

Government departments, which have to do with the country's industries, are administered at all points with the interests of those industries fully in view, and, if those operating the industries neglect to make the most of the results offered them, it is nothing to the discredit of the departments, but simply shows the lack of alertness of the business managers of those industries. The Bureau of Mines, and other similar departmental work is worthy of the heartiest support, and its work of the careful attention and study of workers whose field it covers.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

of Practical Engineer, published Semi-Monthly at Chicago, Ill., required by the Act of August 24, 1912.

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Chas. Sanford Clarke, Sec'y.

Sworn to and subscribed before me this 1st day of April, 1914. Warren A. Lathrop,

Notary Public.

[Seal.] (My commission expires October, 1914.)

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Measuring, Heating and Purifying Feed Water

MEASUREMENT of the flow of water has, for many years, been made by use of weirs, the rectangular notch being used for large quantities such as are dealt with in hydraulic work, with the equation determined by Francis. For less quantities, such as are handled in steam plants, the size of rectangular notch made necessary and the small head result in errors, especially where the flow varies considerably. The V-shaped notch is, therefore, more desirable for such cases, as the head changes rapidly with change in flow. Professor James Thomson determined the value for flow over such a weir with angle of 90 deg. to be:

$$\text{Cu. ft. per min.} = 0.305\ H^2\sqrt{H},$$

in which H is the head in inches above the apex of the notch. This involves only one dimension, as the ratio

FIG. 1. HOPPES METER TANK WITH V-NOTCH RECORDER AND INTEGRATOR

of depth to breadth is always the same in a triangular stream. This determination, made in 1860, was checked at Glasgow University, 1907-9, and the accuracy found to be ⅓ of 1 per cent. Several meters have been designed, based on the use of the V-notch weir, various methods being employed for operating indicating and recording instruments to show and register the flow.

The Hoppes V-notch recorder and integrator developed by the Hoppes Mfg. Co. of Springfield, O., uses a vessel to weigh the head on the weir at every instant by balancing the head against the pull of a spring; the vessel is so shaped that, at each head, it holds the right amount of water to pull down the spring just in proportion to the rate of flow through the notch.

As seen in Fig. 1, the meter consists of a cabinet, attached to the tank by a bracket, and having on the inside a vessel, A, Fig. 2, suspended by a coil spring, B, and connected to the tank by a flexible metal-hose water connection, C, and the flexible equalizing connection,

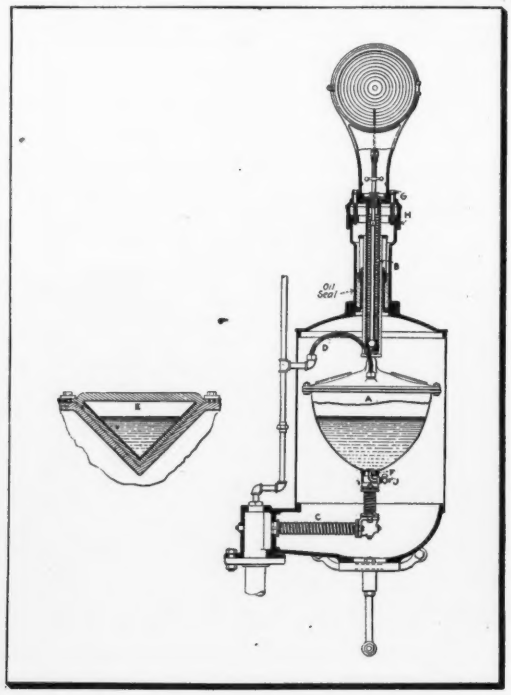

FIG. 2. SECTION OF V-NOTCH RECORDER AND INTEGRATOR, SHOWING RELATIVE POSITION OF NOTCH AND WEIGHING VESSEL

D, at the top. Connection C is attached to the tank behind the V-notch, keeping the water in the vessel, A, always at the level of the water above the weir.

As shown in Fig. 2, the V-notch, E, in the tank is placed opposite vessel, A, in the meter; its height is 8 in., and the water shown is 6 in. over the angle. Drop of the vessel for a full 8-in. weir is approximately 4 in. and at 6-in. head the drop is 2 in., giving 8 in. of water above the upper end of the curved tube, F, at the bottom of the vessel. This draws down spring B, to which the recorder and integrator are directly attached, in exact ratio to the rate of flow.

Adjustment of the head to bring the vessel to the proper height is by loosening the 2 screws, G, in the head, and raising or lowering the head by means of the band, H. The height of A relative to the V-notch is important, and adjusted by filling the tank and lower

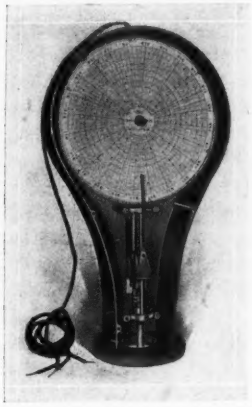

FIG. 3. INTERIOR OF RECORDER, SHOWING GUIDE AND PEN
FIG. 4. DISK SIDE OF RECORDER, SHOWING PLANIMETER WHEEL AND INTEGRATOR

connections of the vessel with water until a small amount runs through the V-notch. The water is then allowed to run out until it is at the lowest point in the V-notch, when the pet-cock, J, is opened. If the instrument is correctly adjusted, water will drop slowly from the pet-cock, showing that the lowest point in the vessel is on a level with the V-notch. Should no water show at the pet-cock, the vessel should be lowered; should the water flow too freely, the vessel should be raised until the water nearly ceases to flow, care being taken always that the vessel, A, is at rest.

After the vessel is adjusted and the screws, G, in the head are tightened, the pen should be brought to the neutral line near the center of the chart by adjusting the screw connecting the top of the rod with the crosshead, Fig. 3, which adjustment should bring the planimeter wheel in the rear to the center of the dial.

When regulating the height of the vessel the brass sleeve through which the rod passes must be adjusted so as to give clearance for the stops on the rod below and above the sleeve.

Recording and integrating apparatus is located in the circular case above the cabinet. A clock movement operates on one side, making one revolution in 24 hr., and on the other side an aluminum disk making one revolution an hour. These are shown in Figs. 3 and 4.

Below the chart is a vertical guide with crosshead, as shown in Fig. 3, connected to the vessel, A. To one side of the crosshead is attached the pen for making the record on the chart, and an arm on the other side supports a small planimeter wheel on a vertical axis, which is revolved by the disk, Fig. 4. This planimeter wheel moves a train of gears to operate the integrator, and registers the pounds of water that have passed the weir.

FIG. 5. ELECTRIC INTEGRATOR FOR DISTANT RECORDING

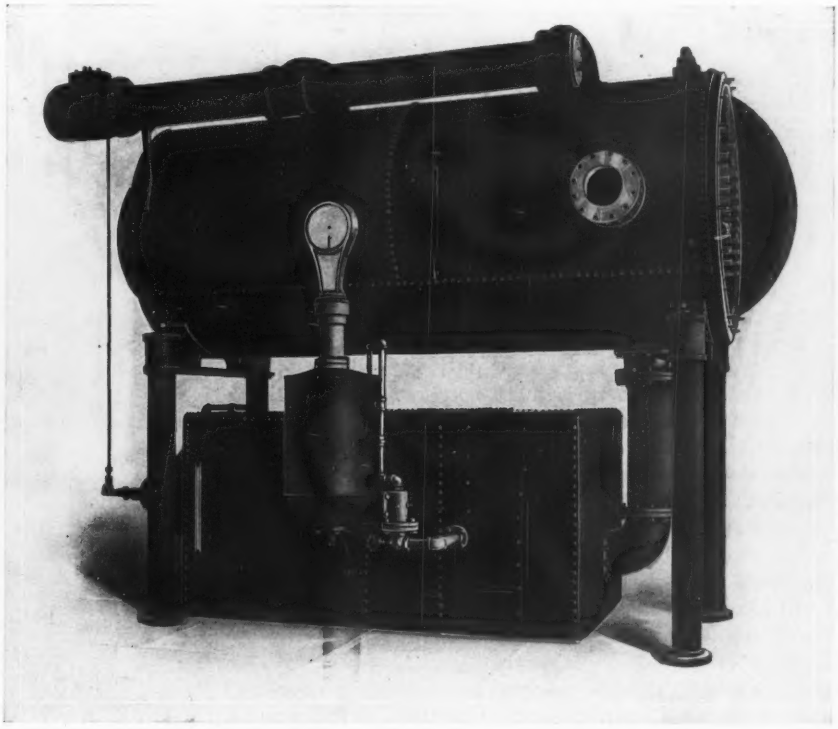

FIG. 6. HOPPES FEED-WATER HEATER WITH WATER METER

With the water just starting over the weir, the planimeter wheel rests at the center of the disk. As the head increases and the vessel, A, Fig. 2, descends, the planimeter wheel is drawn down and rotated faster by the disk, which has a constant motion, giving a correct record of the water passing the weir. If the meter is located in an inaccessible place, the planimeter wheel may be provided with a commutator and wire connection carried to an electrically operated integrator, Fig. 5, located at any distance.

Charts used on the recorder are 12 in. in diameter, giving records easily read and conveniently filed.

Tanks to contain the weir and support the cabinet are made of cast iron, wrought iron or steel and arranged for use in connection with the Hoppes heaters or other service with automatic water regulators to maintain the water level constant in the tank. The V-notch is of phosphor bronze, held in place by studs and nuts, so that it can easily be replaced by a larger or smaller notch if wider range is desired than a single notch can give. Any kind of flowing liquid, hot or cold, can be measured, the machines having been built

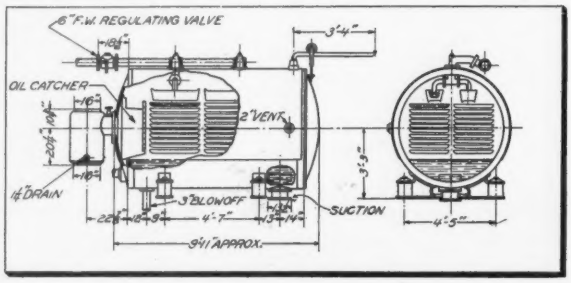

FIG. 7. INTERIOR OF CLASS R HEATER

from 25,000 to 800,000 lb. an hr. capacity, and they can be built for any capacity.

Figure 6 shows the machine connected to a Hoppes open feed-water heater. Exhaust steam comes to this heater through an oil separator and catcher attached to the left-hand head, and surplus steam passes out from the side nozzle in front. Feed water is admitted by the automatic valve in the pipe at the top, the valve being controlled by the float at the left of the weigher tank to hold the water level constant in the suction chamber of the tank, which is reversed in position from the tank in Fig. 1. Hot water from the heater descends through the bottom nozzle into the weir end of the weigher tank, and is weighed in passing to the suction chamber.

Inside the heater, the arrangement is as shown in Fig. 7. Water is distributed through 2 nozzles, having 2 branches each into 4 troughs, and from these overflows into 4 series of pans forming a film along the undersides of the pans and depositing impurities in the pans and on their under surfaces. The purified water falls to the bottom of the heater, where floating matter is drawn off by a skimmer overflow and sediment drops to the bottom and is blown out. Over the suction pipe, which extends in a nipple through the bottom of the shell, thus avoiding the drawing in of sediment, is a hood with wings resting in slots in the nipple, thus preventing any floating matter from entering the outlet.

Pans and troughs are readily removed for cleaning by detaching and swinging to one side the front head, for which purpose a crane arm is mounted on the shell of the heater at the front end.

Bristo Safety Set Screws

THE hollow head of this screw is equipped with 6 dove-tailed flutes or slots, into which the corresponding dove-tailed projections of the wrench fit. The effect of this dove-tailed design is such as to eliminate the tendency for the wrench to expand or split the hollow head when the screw is set up, even though considerable pressure be applied to the handle of the wrench. Instead, however, the wrench gives the screw a true rotary motion, due to the angles at which the bearing surfaces of the slots are located, with the result that the tendency is for the wrench to contract or compress the screw head.

This feature adapts the set screw for use where it must be removed or set up and loosened repeatedly, as, for instance, in lathe dogs which require frequent adjustment.

FIG. 1. TOP VIEW OF BRISTO SAFETY SET SCREW

FIG. 2. SIDE VIEW OF BRISTO SET SCREW

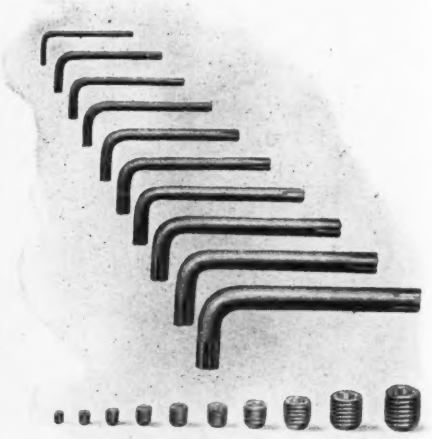

FIG. 3. VARIOUS SIZES OF BRISTO SET SCREWS AND WRENCHES

By means of a special treating process, the screws are made glass-hard on the outer surface and extremely tough on the inside.

On account of the progress of the "safety first" movement, much attention is now being given to changing the design of machinery to protect human life, the safety set screw being one of the things on which safety engineers and inspectors insist.

These screws are furnished in a variety of sizes, a few of which are shown in Fig. 3. They are manufactured by the Bristol Co., of Waterbury, Conn., and, at the First International Exposition of Safety and Sanitation recently held in New York City, a silver medal was awarded the Bristol Co. in connection with its exhibit of safety set screws.

News Notes

WIGHTMAN & RICHARDS, counsellors and consulting engineers in technical advertising, report the removal of their offices from 29 Broadway to 50 Union Square, New York City.

THE BROWNELL CO., Dayton, Ohio, announces that I. E. Jones, formerly in charge of sales department, has been appointed by the Board of Directors as general manager of this company.

WORKMEN ARE laying the foundation for the new Holt and Brandon electric ice factory in Evansville, Ind. The building will be finished and in operation in May.

CONNECTICUT ASSOCIATION of Stationary Engineers will hold its annual meeting at Bridgeport, Conn., June 26 and 27, in Eagles Hall. Information in regard to space, shipment, etc., can be had from Edward S. Birge, Secretary, 240 Stratford Ave., Bridgeport, Conn.

THE DEARBORN CHEMICAL CO. has transferred its southeastern branch office from Birmingham, Ala., to Atlanta, Ga., 1407 Candler Bldg., where C. H. Everett and J. F. Boutelle, representing the Dearborn Company in that territory, will have their headquarters.

WALTER M. FULLER desires to announce that on May 1, 1914, the firm of Linthicum, Belt & Fuller will be dissolved at the expiration of its term and that after such date he will continue the practice of patent and trade-mark law at his present offices, 717 Monadnock Bldg., Chicago.

JOHN ERWOOD, Consulting Engineer and inventor of many steam specialties, which bear his name, died at his residence in Chicago, on April 14. Mr. Erwood was born in London, in 1859, and came to the United States when 20 yr. old. He has been associated for the last 25 yr. with the Thomas B. Jeffrey Co., of Kenosha, and has also done work for many other firms. He is survived by a widow and 5 children.

THE AMERICAN BOILER MANUFACTURING ASSOCIATION will hold its Twenty-sixth Annual Convention in New York City, Sept. 1 to 4, 1914, inclusive, with headquarters at the Waldorf-Astoria Hotel. All boiler, tank and stack manufacturers and fabricators of steel plate, also manufacturers and representatives of materials and supplies used by boiler manufacturers are invited to attend the convention. Complete information furnished upon request to F. B. Slocum, secretary Supplyers' Association, West & Calyer Sts., Brooklyn, N. Y.

IN ORDER to further the welfare of the engineering profession, and to develop the standing of the engineer as a factor in the social structure, the Technical League of America has been founded by recent combination of the American Society of Engineer Draftsmen engaged in commercial fields, and the Technical League of Engineers, which was a society among Civil Service Departments. The objects of the League are to obtain for the engineer and his assistants, proper recognition, both economically and socially. Full particulars can be had from Walter M. Smyth, General Secretary, 74 Cortlandt St., New York City.

THE SOUTH GEORGIA POWER CO., a new concern which has just been formed at Valdosta, to develop a water power proposition on the Withlacoochee River, expects to begin active work within the next few weeks. The company will begin business with a nominal capital of $25,000, but in its petition for charter, asks the privilege of increasing the capital to $2,500,000. It will build a dam across the Withlacoochee River 4 mi. northwest of Valdosta, and expects to develop sufficient electric current to supply the needs for light and power in all the towns throughout the section. The dam and power station will be located near the crossing of the Valdosta, Moultrie and Western Ry., and the majority of the incorporators are heavy stockholders in the railroad. Whether there is to be any connection between the railroad and the power company, is not stated.

THE FOLLOWING foreign trade opportunities are reported in the Daily Consular and Trade Reports:

No. 12763. An American consular officer in South Africa states that he is in receipt of a request from a local business man for the names of American manufacturers of the following articles: Electrical machinery, motors, paints, oils, brushes, windmills, etc. Illustrated catalogs, price lists, quotations, terms, etc., are desired. Correspondence may be in English.

No. 12766. A merchant in a European town desires catalogs and prices of American electric torches and pocket lamps. Correspondence should be in German, and prices c.i.f. Hamburg, Trieste, or Fiume, if possible.

No. 12767. The governor general of a foreign city has invited tenders for sewerage, waterworks, paving, rebuilding slaughterhouses, and market hall. American engineers backed by capital should be sent to bid upon these works. Time limit is June 14.

Addresses may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or at the branch offices of the Bureau. Apply for addresses in letter form, giving file numbers.

THE UNITED STATES CIVIL SERVICE COMMISSION announces an open competitive examination for junior mechanical engineer, for men only, on May 20, 1914, to fill vacancies in the Interstate Commerce Commission, under the act providing for the valuation of the property of common carriers, at salaries ranging from $1080 to $1500 per annum. Competitors will be examined in the following subjects, which will have the relative weights indicated: 1, Mathematics, including algebra, geometry, trigonometry, and applied mechanics, 30; 2, Theory and practice of railway mechanical engineering, 30; 3, Education, training, and experience, 40. Persons who desire this examination should at once apply for application Form 2039 to the United States Civil Service Commission. In applying for this examination, the exact title, Junior Mechanical Engineer (Male), should be used.

FOR JUNIOR electrical engineer, examination will be held on May 20, 1914, to fill vacancies as they may occur in this position in the Interstate Commerce Commission, at salaries ranging from $1080 to $1500 per annum. Competitors will be examined in the following subjects, which will have the relative weights indicated: 1, Mathematics, including algebra, geometry, trigonometry, and applied mechanics, 30; 2, Theory and practice of railway electrical engineering, 30; 3, Education, training, and experience, 40. Persons desiring this examination

should at once apply for application Form 2039 to the United States Civil Service Commission, using the exact title, Junior Electrical Engineer (Male).

FOR JUNIOR structural engineer, for men only, examination will be held on May 20, 1914, to fill vacancies as they may occur in this position in the Interstate Commerce Commission, at salaries ranging from $1080 to $1500 per annum. Competitors will be examined in the following subjects, which will have the relative weights indicated: 1, Mathematics, including algebra, geometry, trigonometry, and applied mechanics, 30; 2, Theory and practice of the use of steel, concrete, and masonry in railway structures, 30; 3, Education, training, and experience, 40. Persons who desire this examination should at once apply for application Form 2039 to the United States Civil Service Commission. In applying for this examination the exact title, Junior Structural Engineer (Male), should be used.

EXAMINATION for junior railway signal engineer will be held for men only, on May 20, 1914, to fill vacancies as they may occur in this position in the Interstate Commerce Commission, at salaries ranging from $1080 to $1500 per annum. Competitors will be examined in the following subjects, which will have the relative weights indicated: 1, Mathematics, including algebra, geometry, trigonometry, and applied mechanics, 30; 2, Theory and practice of railway signaling, including questions relating to block signals, interlocking plants, and the electrical equipment which is a part of such railway signal apparatus, 30; 3, Education, training, and experience, 40. Persons who desire this examination should at once apply for application Form 2039 to the United States Civil Service Commission, Washington, D. C. In applying for this examination, the exact title, Junior Railway Signal Engineer (Male), should be used.

Book Review

A READER OF SCIENTIFIC AND TECHNICAL SPANISH, with a vocabulary and notes, by Cornelis DeWitt Willcox, 12mo., illustrated; price, $1.75 net, postpaid $1.90. This is a book for engineering students who are preparing themselves for the practice of their profession in Spanish-speaking countries, and should equip those who have mastered it with a substantial knowledge of Spanish technical words. It should, further, familiarize them with the manner in which technical subjects are presented in the Spanish language.

After briefly touching upon the subjects of Physics proper and Chemistry, the compiler has brought together, articles, extracts, etc., bearing upon Steam, Electricity, Automobiles, Aeronautics, Topography, Mining, Bridges, Railroads, etc., etc. Few notes have been furnished, and only where they seemed indispensable. On the other hand, the vocabulary contains more or less information which otherwise would have been presented under the form of notes. This book is intended for students who have already acquired some knowledge of the language as such, and who therefore, in a measure, are independent of mere grammatical references.

IN LOCATIONS, such as mines and gas works, where inflammable or explosive gas mixtures are liable to be present, electric switches, when used, need be of such form that no spark is produced on breaking the circuit. Tests of the Bureau of Mines have shown that a 250-volt d.c. switch, carrying ½ amp., will cause a flash that will ignite explosive mixtures, which proves the need of protecting against flash where gas is present.

Tests of switches arranged for this purpose have been made by the Bureau, and the results are given in a pamphlet by H. H. Clark and R. W. Crocker on Electric Switches for Mine Use. Two general methods are used for safeguarding; one by enclosing the switch, and covering all openings with fine wire gauze, as in the Davy safety lamp; the other by immersing the contacts in oil, as for oil break switches used for high voltage. For this type, oil of proper quality must be kept at the right level to surround the contacts or the switch loses its safety quality, and as oil is subject to leakage and evaporation, the authors conclude that the enclosed or "explosion proof" type has a greater element of permanent safety if of durable construction. The Bulletin, No. 68, gives the details of switches tested, methods of testing and results and remarks on the strong and weak features of each switch.

The Bureau has decided to undertake tests to establish a list of permissible switches for such service, and the character of tests to be passed are given in the bulletin.

RAPID PROGRESS IS BEING MADE in working out the final program of papers for the International Engineering Congress to be held in San Francisco in 1915.

The first volume of the publication of the Congress will consist of a series of articles descriptive of the various technical features of the design and construction of the Panama Canal. The various topics which will be treated are noted in the following list:

(1) Introductory Chapter.
(2) Dry Excavation for the Panama Canal.
(3) Dredging in the Panama Canal.
(4) Terminal Works, Dry Docks, and Wharves of the Panama Canal.
(5) Permanent Shops of the Panama Canal.
(6) Coaling Plants and Floating Cranes of the Panama Canal.
(7) Meteorology and Hydrology of the Panama Canal.
(8) Design of Locks, Dams, and Regulating Works of the Panama Canal.
(9) Method of Construction of the Locks, Dams, and Regulating Works in the Atlantic Division of the Panama Canal.
(10) Method of Construction of the Locks, Dams, and Regulating Works in the Pacific Division of the Panama Canal.
(11) Design of Lock Walls and Valves for the Panama Canal.
(12) Design of the Spillways on the Panama Canal.
(13) Gates of the Panama Canal Locks.
(14) Electrical and Mechanical Installations of the Panama Canal.
(15) Emergency Dams above Locks of Panama Canal.

(16) Municipal Engineering and Domestic Water Supply in the Canal Zone.

(17) Reconstruction of the Panama Railroad.

(18) Aids to Navigation of the Panama Canal.

(19) Geology of the Panama Canal Zone.

(20) The Working Force of the Panama Canal.

(21) Sanitation in the Panama Canal Zone.

(22) Purchase of Supplies for the Panama Canal.

Each of these topics will be treated by someone on the canal force who has been responsible for the design and construction described. The introductory chapter as well as the topic of Dry Excavation for the Panama Canal will be handled by Colonel Goethals, himself.

This volume will constitute practically an official technical record of the gigantic engineering feat which is just nearing completion and will be of interest, not only to engineers but to laymen.

No similar volume has as yet been prepared upon the canal, nor is it probable that any such will be in the future. The advantage is being taken of the Congress to draw together under one cover in this way the statements of the men who have been responsible for the work.

Catalog Notes

HIGH PRESSURE portable engines, designed and built by The Enterprise Co., Columbiana, Ohio, are described in one of the company's recent catalogs.

THE LUBRICATING METAL CO., 2 Rector St., New York, has issued a booklet describing and illustrating Noheet bearing metal and packing.

YARNS, a pamphlet published monthly by American Mfg. Co., Brooklyn, N. Y., is devoted to rope and contains pictures showing "American" rope in service.

ARMSTRONG STEAM TRAPS are described and illustrated in a new 16-page pamphlet from Armstrong Machine Works, Three Rivers, Mich.

LARGER SIZES of vertical blowers with plate on top for carrying electric motor, motor and blower being connected by a belt, are illustrated in Bulletin No. 27, from The Connersville Blower Co., Connersville, Ind.

BALL BEARING HANGERS manufactured by The Hess-Bright Mfg. Co., Front St. and Erie Ave., Philadelphia, are illustrated and price lists are given in a booklet from the company.

A KEY to Higher Efficiency in the Boiler Plant is the title of Bulletin No. 6 on the Blonck boiler efficiency meter, manufactured by W. A. Blonck & Co., Fisher Bldg., Chicago.

CIRCULARS FROM Manufacturing Equipment and Engineering Co., 209 Washington St., Boston, Mass., illustrate metal chairs, sanitary bubbling fountain, sanitary washbowls in batteries and other shop, factory and public equipment.

SWING CHECK AND GATE Valve in One, is the subject of a circular just issued by Nelson Valve Co., Chestnut Hill, Philadelphia.

Another new circular from that company is devoted to steel valves.

SEVERAL BULLETINS are being sent out by Stow Mfg. Co., Binghamton, N. Y., describing some of the company's portable electrical tools. These include an electric breast drill, tool post grinder, electric bench grinder and radial flexible boring machine.

FOLDER 4237, The Way to Charge 3 Cells, describes the Westinghouse mechanical vibrating rectifier for charging small storage batteries used for ignition and lighting sets for automobiles. This device changes the alternating to direct current by means of the vibrating mechanism. All that it is necessary to do to operate it is to connect the two wires from the binding posts to the battery and turn the switch.

GENERAL ELECTRIC CO. recently issued Bulletin No. 44,590 under the heading, Type ML Governor for Motor-Driven Air Compressors. The function of the Type ML governor is to control automatically the operation of either stationary or railway motor-driven air compressors in order to maintain air pressure in a storage reservoir between predetermined limits. This bulletin supersedes the company's previous bulletin on the same subject.

THE RECENTLY ISSUED general catalog of the New York Belting & Packing Co., 91 Chambers St., New York, an illustration of which is shown here, is as attractive throughout its 230 pages as is the cover, and would be worthy of a place in every engineer's library.

The book is full of halftones from photographs and wash drawings of mechanical rubber goods, showing how they are made and many applications. It also contains price lists and much information in regard to the uses of rubber goods.

Trade Notes

PROVIDENCE ENGINEERING WORKS, Providence, R. I., has undertaken the manufacture of centrifugal pumps, and has engaged as engineer in charge of this work, Albert E. Guy, who has had long experience in this field. The centrifugal pump, either turbine or motor driven, is being rapidly adopted for all kinds of service, and the company will manufacture a line in conformance with the high standards which have been maintained in other lines of its machinery.

WESTINGHOUSE ELECTRIC & MFG. CO. reports a number of important orders recently received from the metal mining industry, indicating lively activity along the line of metal mining. The following are among the more important orders received:

United Verde Copper Co., Jerome, Ariz., one 24-panel switchboard for the new smelter at Clarkdale; El Paso (Texas) Smelting Co., 2 55-hp. direct-current, back-geared motors for operating Stillwell Pierce converters; Magma Copper Co., Superior, Ariz., 9 a.c., squirrel-cage motors, totaling 267 hp., and 90-kva. transformer capacity for operating copper concentrating mill, being built by the General Engineering Co. (an interesting point being that the energy for operating the motors will be supplied from the Roosevelt Dam Power Project); Anaconda (Mont.) Copper Mining Co., 6 150-kva., oil-insulated, self-cooling transformers for the Washoe Smelter, also 14 a.c. motors totaling 290 hp., for driving mine ventilating fans; National Copper Mining Co., Wallace, Idaho, one 4-ton bar-steel locomotive for tandem operation with a locomotive previously purchased; Utah Copper Co., Magna, Utah, 4 15-hp., slow-speed, vertical, d.c. motors, for direct connection to agitators used in oil flotation process (a new application especially developed by the Westinghouse Elec. & Mfg. Co., after considerable experimentation), also 2 50-kw. motor generator sets with switchboards, and 3 100-kw. transformers; Alaska Gastineau Mining Co., Juneau, Alaska, 2 18-ton bar-steel locomotives, especially designed for a low height, for underground and surface haulage; Kennecott (Alaska) Mines Co., one 50-hp., back-geared, a.c. motor and 3 25-kva. transformers; Tonopah Belmont Co., Tonopah, Nev., one 75-hp., a.c. motor, used for driving an Aldrich pump; Brunswick Consolidated Gold Mining Co., Grass Valley, Cal., 3 100-kva., oil-insulated, self-cooled transformers.

THE THREAD TIGHT CO., 2 Rector St., New York City, is in receipt of the following letter, which brings out some of the qualities of the pipe joint compound, "Thread-Tight":

We take pleasure in stating that for nearly 5 yr. we have used "Thread-Tight" for general utility work around our factory, including high pressure steam at 250-lb. pressure, with most satisfactory results.

One peculiarity of "Thread-Tight" is that it can be put onto a wet surface, such as iron pipe submerged in water, and it will adhere to the surface as firmly as if the pipe were dry. We find this of particular advantage in making up couplings for water and steam, where pipes are apt to be wet, and where a joint must be made quickly.

Another advantage in "Thread-Tight" is that it does not become hardened in the joints, thereby injuring the threads when breaking them. We also find that it does not become hardened in the can after being opened up. An ordinary iron pipe union may be screwed together with "Thread-Tight" without a regular rubber gasket being used, and the joint will be absolutely tight.

We can safely say that we have never seen its equal in any pipe compound which has come to our notice, and we feel confident that the same results will be obtained from this material wherever it may be used.

Nathan Manufacturing Co.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

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Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

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Full page, one year, each insertion, $60.00.

Half page, one year, each insertion, $35.00.

Quarter page, one year, each insertion, $20.00.

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Front cover, $150.00 per issue.

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Stippled plates used, but no heavy, black and white plates.

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Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500.

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Position Wanted

POSITION WANTED—As Chief Engineer in Institution, with 10 years' experience in Institution work. Can give best of reference. C. H. Mitchell, 1403 Congress St., Portland, Maine. 5-1-1

POSITION WANTED—As Gas Engine Operator. Have had 4 years' experience. Can do all repair work. Address Box 46, Morton Grove, Ill.

Wanted

IF YOU RECOGNIZE the value of approved specialties in an engine and boiler room as a means of higher efficiency; if you believe in this sort of thing to the extent that you think you could sell a well-known boiler specialty in your territory for an old-established manufacturer in the power-plant field, write and tell us all about yourself. On receipt of your letter we will outline our proposition in full. Address Box 324, Practical Engineer. tf.

WANTED—A small ice-making and refrigerating plant with a daily capacity of about 10 to 15 tons, is wanted by a subscriber. A second-hand plant preferred. Give full particulars. Address Box 341, Practical Engineer. tf.

WANTED—Every local Engineers' Association to have an assortment of valuable power-plant books—Secretary, write at once, for full particulars. Address Dept. C, Practical Engineer, Chicago.

IF YOU ARE a night engineer, spend a few hours each day taking subscription for Practical Engineer. You will be paid well. Write Subscription Dept. They will start you in at once.

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

WANTED—Secretary of local Engineers' Association to write at once in regard to a very interesting proposition. Address Practical Engineer, Circulation Department.

Help Wanted

WANTED—A competent, reliable and experienced chief engineer to take charge of power plant for saw mill and electric driven planer in South. Must be first class electrician and Corliss Engineer. Give reference in first letter. Address Box 344, Practical Engineer. 4-15-2

WANTED—An additional subscription solicitor wanted to cover towns in the State of Oklahoma. Excellent chance to earn extra money. Write to Subscription Department. tf.

For Sale

USE AN AIR-FRICTION with new 1914 improvements. Increases power and economy of motor one-half. Absolutely impossible to choke or load. Uses distillate gasoline or half kerosene with finest results. Starts easy in coldest weather. We fit all motors, guaranteeing definite results or refund money. Exclusive county rights. Liberal exchange on other carburetors. The Air-Friction Corburetor Co., Dayton, Ohio. 2-15-6

FOR SALE—2 Buckeye steam engines at bargain prices. 1 12x21-in., 85-hp., 185 r.p.m., 85-lb. steam pressure, flywheel 6 ft. diameter, 22-in. face. 1 11x18-in., 70-hp., 200-r.p.m., 85-lb. steam pressure; flywheel 4 ft. diameter, 14-in. face. Changed to motor drive. Must move at once. Write today. The W. H. Mullins Co., Dept. A., Salem, Ohio. 4-15-6

FOR SALE—Two 250-kw. Rotary Converters, type E. C., form E, class 6-250-500, 500 r.p.m., 600 volts, d.c.; d.c. amperes 416; a.c. end, 25 cycles, 3 phase, 360 volts. These machines are in A-1 condition and can be delivered at once. Price, $1,400 each, f.o.b. cars (Penna. delivery). F. H. Herring, Inc., 30 Church St., New York. 2-15-6

SPECIALS—Two 75-kw. Westinghouse, 125-volt dynamos, direct connected Ames automatic engines, each $975. Two 75-kw. Crocker Wheeler, 250-volt generators, direct connected Harrisburg Fleming engines, with switchboards, each $1200. Also 350-hp. Heine watertube boilers (30 days' service), 200 lb. steam pressure, $1500. Duzets & Son, 50 Church St., New York. tf.

GENERATOR UNITS FOR SALE—100-kw., 125-volt, direct current, Ft. Wayne generator, direct connected to Watertown engine, speed 275. 300-kw., a.c., 600-volt, 3-phase, 60 cycles Curtis turbine unit. One No. 6, 4-in. connections, Blackburn-Smith feed-water filter and grease extractor. J. F. Miller, 457 Hudson Ave., Albany, N. Y. 5-1-1

GROBET SWISS FILES are the standard of excellence in files, and have been for over 100 years. We send post paid, as an introducer, 48 files especially adapted for tool makers and machinists on receipt of $5.00. This is a chance to get a set of files you'll appreciate and we'll get future orders. Montgomery & Co., 101 Fulton St., New York, N. Y. 5-1-1

FOR SALE—At a Bargain. New 5x6, 4-cylinder governor-controlled engine, fully equipped with carburetor magneto. Will sell for much less than cost. Fred Hanson, 570 Prior Ave., St. Paul, Minn. 4-15-2

FOR SALE—One 95-hp., 3-cylinder Westinghouse producer gas engine and complete equipment for operating suction type. Constant use one year. Practically new. Address, Box 345, Practical Engineer. 4-15-6

TRAVELING CRANE—Wooden—For Sale Cheap. 15-ton capacity, 65-ft. span, suited for either motor or wire rope drive. Write Box 346, Practical Engineer. 4-15-6

OUR MODERN BLUE-PRINT CHART method of electrical wiring. Write for information. Electrical Wiring Diagram Co., Box F173, Altoona, Pa. 11-15-12

Patents and Patent Attorneys

PATENT YOUR INVENTION. Send sketch for free expert search and report as to patentability. Books on inventions and patents, and book of references from congressmen, manufacturers, bankers and inventors sent free. John S. Duffie & Co., 612 F St., N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY. Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for free search. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf.

OFFICIAL DRAWINGS FREE. Patents procured or fee returned. Expert services. Send sketch for Free search. The Patent Exchange, Garban Bldg., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Educational and Instruction

ENGINEERS' POCKET MANUAL, 175 pages edited by University of Tennessee, will be mailed every subscriber sending in NEW subscription (not your own) to Practical Engineer. Gilt edges; bound in leather.

Technical Books

BOOKS ABOUT ELEVATORS—Best published. W. A. Morse, 19 Union Place, Yonkers, N. Y. 2-15-6

Miscellaneous

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you. tf.

Sparks From The Advertising Pages

It has been the purpose of many of the "Sparks" talks to point out the higher value of advertising—the benefit it bestows in addition to commercial stimulation.

In a recent article on "Social Service in Advertising," Mr. J. U. Stokes, formerly Advertising Director for Marshall Field & Co., gives some good thoughts in this connection. The following is an excerpt from his article:

"Good advertising by bringing before the public day by day the riches of the world's markets, the infinite variety of products which satisfy their needs and tastes, has a distinct part in widening men's horizons and enlarging their ideas. This variety of products encourages and develops higher standards of taste, more definite notions of efficiency, for advertising calls attention to the best things and points out their virtues.

"It is genuine social service for advertising to make widely known useful and helpful things which lighten work, which make life and the home more lovely, more livable, and which enlarge the ideas and raise the standards of comfort and convenience. More than that, many of these things contribute to the satisfaction in the home life and to its stability, and, therefore, tend to raise the level of public morals.

"Advertising, then, may soberly and truthfully be said to offer exceptional opportunities for making a strict attention to business conduce not solely to the material prosperity of people with something to sell, but it may also contribute largely and effectively (because it is so constant and compelling a force) to the uplifting of the social, aesthetic and ethical ideals of the whole country by constantly setting before the people the advantages of articles which are honestly and skillfully designed and made, which combine the highest utility with simplicity, grace and attractiveness of form and finish, which increase the permanent and reasonable enjoyments of life, and which inculcate in their manufacture and in the methods used to market them, the highest standards of honor and probity."

The influence of advertising on the equipment efficiency of a power plant is tersely explained in a letter from Mr. John Pierce, Alva, Okla.:

"I give fully as much time and thought to the advertising section of Practical Engineer as to the editorial matter. I do this because I know that by closely studying and watching the various changes in engineering appararatus which are described and shown in advertisements, one may learn much about that which he would not otherwise learn."